THE INTELLECTUAL OBSERVER.

NOVEMBER, 1863.

ON THE "SERAPHIM" AND ITS ALLIES.

BY HENRY WOODWARD, F.Z.S.

(With a Tinted Plate.)

PERHAPS there is no class of people more happy in the choice of names for natural objects than our quarrymen and pitmen. Every collector of fossils has heard of the "Fairy-loaves" (*Ananchytes*) and "Thunder-bolts" (*Belemnites*), the "Files" (spines of *Cidaris*), "Bird-tongues" (teeth of *Lamna*), and "Slugs" (palatal teeth of *Ptychodus*, etc.); of "Devil's toe-nails" (*Gryphæa incurva*), "Rams'-horns" (*Ammonites*), "Screw-stones" (casts of Encrinite stems), "Dragon's-skin" (*Lepidodendron*), and "Cupid's-wing" (a form of iron pyrites); possibly also of the "Seraphim," a fossil found in "the Arbroath paving-stone" of Forfarshire, which from the wing-like form of some parts of the shell, and the scale or feather-like markings upon its surface, has given rise to this angelic title among the natives. The fragmentary state in which this curious fossil occurs, rendered its correct determination a matter of extreme difficulty. Professor Agassiz, who was the first palæontologist that undertook to solve this zoological problem, writes*:—"The more I know of this creature, the more I am tempted to believe that it was a *fish;* but how absolutely decide upon it when we have neither head nor tail, but only large wings? It may provisionally bear the name of *Pterygotus problematicus*, Ag. (wing-fish)." Fortunately, however, before the publication of his work on the Fishes of the Old Red Sandstone (1844), Agassiz had an opportunity of examining more perfect remains, collected by Mr. Webster in the neighbourhood of Balruddery in Scotland, by which he was enabled to learn that what he had at first conceived to be a

* Murchison's *Silurian System* (1839, p. 606), "Plate IV., Figs. 4 and 5, belong undoubtedly to the same animal as the Seraphim of the Old Red Sandstone;" and Fig. 6, described as *Sphagodus pristodontus*, Ag., a new genus of fishes, is *now* also known to be the serrated edge of the foot-jaw of a Seraphim.

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fish was, in reality, the remains of an enormous crustacean; and the supposed scales were surface markings on its shell. Although unable correctly to determine the nature of the fragments which he figured in Plate A of his *Fossil Fishes*, Agassiz yet most justly concluded to place it "between the Trilobites and the Entomostraca," making it the type of a new family, and including with it *Eurypterus and Eidothea*, two fossil genera since shown to be closely related to *Pterygotus*.*

In 1855, Professor McCoy published in Sir Charles Lyell's fifth edition of his *Manual of Elementary Geology*, p. 420, a restored figure of *Pterygotus problematicus*, Agassiz, which, now that we have a more correct notion of these queer-looking fellows, seems very much like a funny caricature, such as Edward Forbes not unfrequently indulged in.

In September of the same year, Mr. Robert Slimon read a paper before the British Association at Glasgow,† on the Geology of Lesmahagow, Lanarkshire, and exhibited a collection of *Pterygoti* and other associated fossils from Logan Water, which Mr. Salter described and figured soon afterwards in the *Quarterly Journal of the Geological Society*‡ (vol. xii., 1856), with a Report on the Geology of Lesmahagow by Sir. R. I. Murchison, in which Mr. Slimon's observations are embodied, and his labours as a geologist are honourably and deservedly mentioned. In fact, but for the zeal of that gentleman, we might to this day have remained unacquainted with some of the most perfect and wonderful specimens of the tribe.

The foregoing is a nearly complete bibliography of *Pterygotus* to 1859, when Messrs. Huxley and Salter published in Memoir No. 1 of the Geological Survey, their monograph, comprising eleven species of *Pterygoti* (and one of *Eurypterus*), and illustrated by sixteen folio engravings, and many woodcuts.

On referring to Page's *Advanced Text-Book*, second edition, also published in 1859, although the old generic name *Himantopterus*§ is retained, and some other inaccuracies repeated,

* In June, 1862, Mr. J. W. Salter published in the *Quarterly Journal of the Geological Society*, vol. viii., p. 386, an account of the chelate limbs of *Pterygotus problematicus*, from the U. Ludlow Rock of Herefordshire.

† Mr. David Page also read a paper on the "Seraphim" of the Old Red Sandstone at the same meeting, and exhibited a restoration of it. His observations have been reprinted in the *Advanced Text-Book of Geology*, 1856, p. 135.

‡ Under the generic name of *Himantopterus*, four species are described:—*H. bilobus, H. perornatus, H. Banksii, H. lanceolatus;* and two *Pterygoti*—*P. acuminatus and maximus*. In 1856, Mr. Salter also read a paper at the British Association Meeting on the great Pterygotus of Scotland, and other species.

§ This name having been already used to express a genus of Lepidopterous insects, could not, according to the rules of the British Association, be retained for a section of the Pterygoti.

which we shall presently refer to, it is evident Mr. Page's collection contained more perfect specimens of *P. acuminatus* than the officers of the survey were acquainted with, and which have only been surpassed by specimens very recently obtained for the national collection by Mr. Bryce M. Wright (36, Great Russell Street), and collected by Mr. Robert Slimon, of Lesmahagow. That figured in our plate is perhaps the best example, and represents an almost entire specimen of *Pterygotus** *acuminatus*, Salter (so called from the peculiar pointed form of the tail-joint). It is only one-third the natural size, the original being twenty-seven inches in length. The largest individual of this species I am acquainted with would have measured, if entire, more than three feet in length, and nine inches to one foot across its widest body-segment. The smallest perfect specimen of this species in the British Museum measures six and three-quarters inches in length, and one inch across its widest segment.

P. acuminatus is the largest species found at Logan Water. A restoration in correct proportion to the size of the fragments of the great *Pterygotus anglicus*, from the Lower Old Red Sandstone of Perthshire and Forfarshire, would give us a creature measuring from six to eight feet† in length, and more than a foot wide! It is an interesting fact to notice that the largest crustacean living at the present day is the *Inachus Kæmpferi* of De Haan, from Japan‡ (a brachyurous or short-tailed crab, nearly related to *Maia squinado* of our own shores); whilst the *Pterygoti* are not only related to the lower and more simply organized living crustacea, but those also which are least in the scale in point of size.§

It needs but a slight acquaintance with the Crustacea to perceive that the *Pterygotus* is a most remarkable and anomalous creature. The head alone appears to possess any separate organs, and these are adapted at once to serve the multifarious purposes of feeling, locomotion, prehension, and mastication.‖

The oblong square carapace¶ (A 1), with its large sessile eyes at the anterior angles; the heart-shaped plate in the centre (*e*),

* The genus *Slimonia* of Page, 1856, was founded upon this species, although not properly constructed or defined.

† Mr. Salter is of opinion that *P. problematicus* from the Downton sandstone, and *gigas* from the Ur. Ludlow Rock, attained dimensions fully as large. See his restoration of *P. anglicus* in Murchison's *Siluria*, new edition, 1859, foss. 21, f. 1.

‡ It is not the size of the carapace for which this crab is remarkable, but the extraordinary length of its limbs; the fore-arm measuring four feet, and the others in proportion; so that it covers about twenty-five square feet of ground.

§ Honourable exception must, however, be made in favour of *Limulus moluccanus* (the great King crab) of China and the Eastern seas, which, when adult, measures one and a-half feet across the carapace, and three feet in length!

‖ The feet in some Crustacea also serve the office of branchiæ.

¶ Not seen *in situ* in the large specimen, but figured separately A 1.

called the *metastoma*, or post-oral plate,* covering the buccal cavity;† the three pairs‡ of simple, many-jointed, and spiny palpi (*a*, *b*, *c*); the two broad and oar-like appendages, evidently serving as organs of natation (*d d*), like the last pair of feet in recent swimming crabs (see woodcut, Fig. D, foot of *Platyonichus ocellatus*). Each pair of organs have their terminal joints serrated at their basal edges, thus serving the offices of foot-jaws and mandibles.

The thorax and abdomen are composed of twelve joints or segments, which are terminated by a finely-pointed, spear-shaped tail-plate. The first six segments have each a pair of sub-central, spine-like ridges near their posterior margin, probably indicating the points of attachment for muscles within, and are ornamented upon their surface with those peculiar scale-like markings (Fig. *h a*) which led Agassiz at first to place them in the class of fishes, as already stated. No appendages of any kind have been found belonging to the body segments of these animals, except that about to be described. This plate, seen *in situ* in our engraving (*f*, and also in woodcut, Figs. G and K, *m*), covers the ventral surface of the first thoracic§ segment, and is divided into three parts—a median lobe, the extremity of which overlaps the succeeding segment, and two lateral lobes united with it, forming the "conjoined *epistoma* and *labrum*" of Messrs. Huxley and Salter. This plate is placed in front, on the under side of the head, in the restored figure of *P. anglicus*, given in Murchison's *Siluria*, already referred to (see foot note, page 231). Mr. David Page was so fortunate as to possess proof of the true position of this curious segment, which he has figured in the second edition of his *Text-Book of Geology* (1859), p. 163, Fig. B, and it is there described as "the anal plate;" but I am not acquainted with any of the *Articulata* in which that plate occurs in the position indicated; indeed, there does not appear to be any authority for such a determination.

On recently examining some scorpions from Smyrna, I was much struck by the analogy existing between the general arrangement of their organs and those of *Pterygotus*. The locomotory appendages, for example, are all cephalic, and their

* Serving in place of a lip, or lower jaw in higher animals; the true mandibles and accessory organs of manducation working *laterally* in nearly all the Articulata.

† The specimen is lying upon its back, having, therefore, the ventral surface displayed to view.

‡ Five pairs of organs are known to have existed, see restoration.

§ This appears really to consist of two parts, or segments united together; that next the head being much narrower than the other, thus making the number of segments twelve, as stated, without the tail-plate. This number of segments can be distinctly made out in *P. bilobus*, and both Mr. Slimon and I consider it also demonstrable in *acuminatus*.

basal joints serve the office of *palpi*. The two first pairs of organs are chelate. The eyes are six to eight in number, and are placed, two near the centre, and two or three upon each anterior angle of the carapace. The body segments are robust, and the tail long and narrow, and terminated by a cordiform tail-plate, finely pointed at its tip. The reproductive organs are placed immediately behind the mouth; but as the scorpions belong to the *Arachnida* (a division of the *Insecta*, which, although closely approaching the *Crustacea*, is distinguished from them by always breathing by means of *tracheæ*, whilst the latter are furnished with *branchiæ*), we must seek for true affinities among the *Crustacea*, properly so called.

In *Limulus* the true organs of locomotion may be said all to belong to the cephalothorax, and are arranged around the mouth, their basal joints serving the office of *palpi* and mandibles (see woodcut, Fig. A). The abdomen is furnished on its under side with a series of lamellæ; the first of which (Fig. B) overlaps and nearly conceals the succeeding five. They are all exactly like the upper one externally; being, in reality, only a modification of the abdominal swimming feet of the lobster and other *Macrura;* but the first is said to belong to the thorax, and carries upon its inner surface the reproductive organs (Fig. B, *a*), whilst the five which succeed it support and shield the *branchiæ*, or gills. These organs of respiration are constantly vibrating during life, as may be seen in the specimens kept in the fish-house of the Zoological Gardens. The eyes are placed on either cheek, upon the upper surface of the horseshoe-shaped carapace, very much as in the Trilobites. They are compound, and present a beautiful facetted structure when seen through a pocket-glass. Two larval eye-spots may also be detected in the centre of the carapace* in front. Although the shell of *Limulus* appears to be composed of only two parts—the one representing the cephalo-thorax, and the other the abdomen, terminated by a long, powerful, spine-like appendage—yet, on examining it carefully beneath, we see traces of sutures, indicating the division of the abdomen into five separate segments, as in many other crustacea.†

The first organs of *Limulus* are a pair of small *chelæ* placed in front of the mouth (woodcut, Fig. A 1); they correspond to

* Larval eye-spots are found both in the *Pterygoti* and *Eurypteri* of America; see Hall's *Palæontology*, and also in the carapace of the great *Pterygotus anglicus* of England.

† Several small *Limuli* occur both in the coal measures of Coalbrookdale and in Ireland, and it seems probable, from Mr. W. H. Baily's observations, that their abdominal segments were moveable and not fixed, as in the living King crabs. See explanation of sheet No. 137, p. 12—14, Geological Survey, Ireland, 1859, and *Annals and Mag. Natural History*, s. 3, vol. ii., pl. 5.

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the antennules of higher crustacea; the second pair (A 2) are much larger, but chelate like the first; these are the *antennæ*, their bases serving as *palpi*, or foot-jaws. These and the three succeeding pairs of organs (A 3, 4, and 5) are alike in the female *Limulus*, but in the male the antennæ are peculiarly modified (woodcut, Fig. C)—a sexual distinction found also to exist in many other living crustacea.

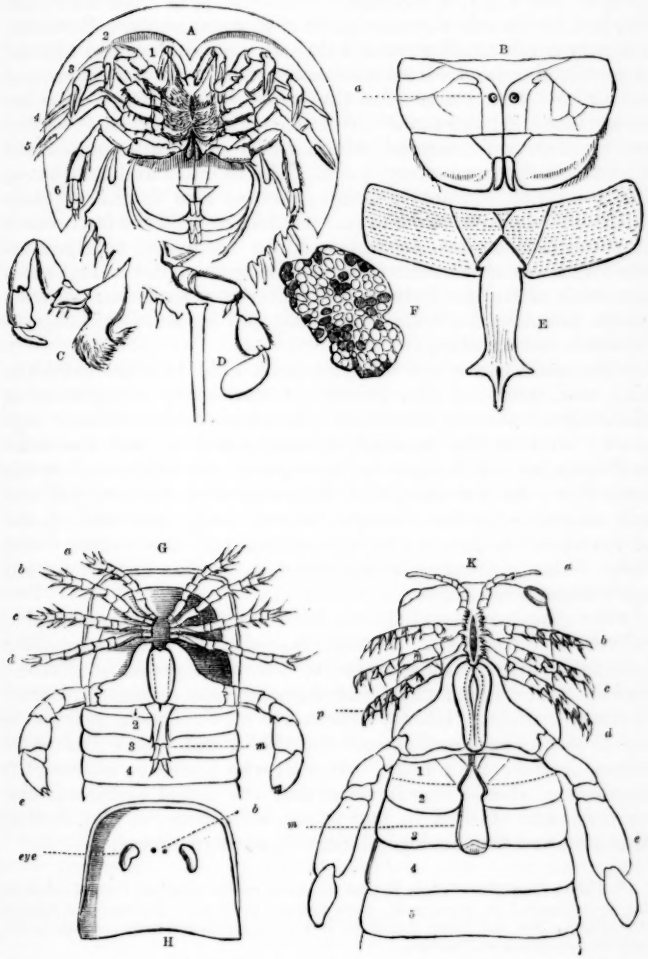
I have thus minutely described *Limulus* because of its affinity to *Pterygotus*, and to its fossil congener *Eurypterus;* and now that we are enabled to give a correct restoration of *P. acuminatus* (see woodcut, Fig. K), its relation to the living form is still more clearly seen.

Having fully satisfied myself as to the general homologies that existed between the nature and position of the organs of the living *Limulus* and scorpion, and the extinct *Eurypterida*, especially as to the identity of the thoracic appendage already referred to, my satisfaction was very much increased on subsequently finding that, in 1859, Professors Hall and Agassiz in America, and, some years since, Mr. Robert Slimon in Scotland, had each independently arrived at the same conclusion, from the study of widely different specimens of the same fossil group.

Mr. Hall writes (p. 394*), "Professor Agassiz regards the central organ attached to the lower side of the first segment as similar to the appendage attached to the membranous feet behind the swimming feet of *Limulus* (see woodcut, Fig. B); and, instead of being double, is anchylosed as in young *Limulus*. Since my comparisons had been made almost entirely with *Limulus*, I am prepared to appreciate these views of Professor Agassiz."

Mr. Slimon writes me, "It is a number of years since I found that plate (see frontispiece, *f, g*, and woodcut, Fig. K *m*), but it being detached I could form no conception of what it was, and many palæontologists who saw it were equally at a loss to explain its nature. At last I found one *in situ*, which threw some light on the subject; still its use remained a mystery. After some time I obtained the other kind of plate (see woodcut, Fig. E), attached to an individual of the same species (*P. acuminatus*). This led me to the conclusion that it was connected with the sexual organs, and that one form of plate would indicate the male and the other the female. Lately I have observed something like eggs (Fig. F) lying near plate E; so, probably, this may prove to be the female." * *

* See *Geological Survey of New York*, vol. iii., "Palæontology," 1859, by James Hall, Esq. On the genus *Eurypterus*, pp. 392—413; *Dolichopterus*, pp. 414, 415; and *Pterygotus*, pp. 416—419. Plates 80, and nine following plates, and plate 84 *a*. From which the figure of the head of *Eurypterus* (restored) is copied (woodcut, Fig. G).



NOTE.—For explanation of these figures see page 237.

* * * "I have also observed two forms of thoracic plates in the other species (*P. bilobus*)."*

We have given a figure of the upper portion of *Eurypterus remipes* (De Kay), after Hall's *Palæontology of New York, loc. cit.*, and by its side the same parts of *P. acuminatus*. *P. bilobus* is a very much smaller species than *P. acuminatus*, and instead of small, simple, and slender antennules,† it has large and strong *chelæ* or claws like the great "Seraphim," only on a very much smaller scale. The succeeding organs in *P. bilobus* are slender and unarmed, whilst those of *P. acuminatus* are robust and spiny on every joint. The thoracic and tail-plates, too, are quite distinct in shape, and so also is the cephalic shield and the form of the eyes. Feeling as I did the importance of these distinctions, amounting to far more than specific characters, I was much rejoiced at obtaining the independent sanction both of Messrs. Huxley and Salter to place it in a separate genus, adopting for it the name proposed by Mr. David Page—*Slimonia acuminata*.‡

The additions which we have been able to make (with the kind assistance of Mr. Slimon) towards the completion of *Slimonia acuminata*, consist in indicating another thoracic segment; so that the number of body joints is now the same in *Pterygotus* and *Eurypterus*, increasing the number of organs from three to five pairs, and demonstrating the true position and character of the thoracic plate. Only one other point of interest remains to be solved, namely, the position and form of the respiratory organs, and upon this subject we are not without good hope.

We must now conclude our brief sketch of this remarkable palæozoic crustacean. Those who wish to enter more fully into their history must refer to the monograph of Messrs. Huxley and Salter, the Quarterly Journals of the Geological Society, Professor Huxley's Lectures on Crustacea (printed in the *Medical Times and Gazette* for 1857), and Hall's *Palæontology of New York* for 1859. And all who desire to observe for themselves, should bear in mind that the actual specimens can be seen and studied in our public collections at the British Museum, and the Geological Survey, Jermyn Street.

* The median lobe of plate E, and an almost entire detached thoracic plate of the form figured in woodcut K, were figured in Messrs. Huxley and Salter's monograph; but, not being found *in situ*, were attributed to the mouth as the conjoined epistoma and labrum.

† The antennules of *P. acuminatus* have their basal joints serrated, so as to form the first pair of mouth organs. The antennules of *P. bilobus* do not seem to be furnished with serrated basal joints, a most important distinction.

‡ Page's *Advanced Text-Book of Geology*, 1856, p. 135, f. 3; in compliment to my friend, Mr. Robert Slimon, of Lesmahagow, the discoverer of all the Lanarkshire specimens.

EXPLANATION OF PLATE OF *Slimonia* (*Pterygotus*) *acuminata*, SALTER SP.—Fig. A 1. Carapace of *S. acuminata*, about one-third natural size, showing the sessile eyes at the angles of its anterior margin (the antennules are not clearly to be seen in this specimen) : *a*, first pair of simple palpi (*antennæ*) ; *b*, second pair of ditto (mandibles) ; *c*, third pair of ditto (first *maxillæ*) ; *d d*, entire swimming feet, with their broad basal joints, whose serrated edges serve the office of *maxillæ* ; *e*, post-oral plate, or *metastoma* ; *f*, thoracic or genital plate, covering reproductive organs, and concealing the two first thoracic segments, with its median lobe (*g*), which was described as the conjoined epistoma and labrum ; *h*, *i*, *k*, *l*, third, fourth, fifth, and sixth thoracic segments, the first and second are concealed beneath the thoracic plate (*f*) ; *m*, *n*, *o*, *p*, *q*, *r*, six abdominal segments. The thoracic segments are broad and short, whilst the abdominal are long and narrow ; *s*, telson or tail-joint ; *h*, *a*, a small portion of one of the thoracic segments highly magnified, showing the characteristic squamose markings upon its surface.

EXPLANATION OF WOODCUTS.—Fig. A. Recent *Limulus*, "King crab" (female) : 1, antennules ; 2, antennæ ; 3, mandibles ; 4, first maxillæ ; 5, second maxillæ ; 6 (swimming feet), third maxillæ. Fig. B. Thoracic appendage, covering reproductive organs (*a*). Fig. C. Antenna of a male *Limulus* (recent). Fig. D. Foot of swimming crab (recent), *Platyonichus ocellatus*. Fig. E. Thoracic appendage of *Slimonia acuminata*. Fig. F. *Parka decipiens*, supposed eggs of *Pterygoti*. Fig. G. Head of *Eurypterus remipes*, De Kay (after Hall's figure), *under side*, exhibiting the organs of the mouth : *a*, antennule ; *b*, antennæ ; *c*, mandibles ; *d*, first maxillæ ; *e*, (swimming feet) second maxillæ ; *p*, post-oral plate, or metastoma ; *m*, thoracic appendage ; 1, 2, 3, 4, thoracic segments. Fig. H. Upper side of same, showing the eyes, and (*b*) larval eye-spots. Fig. K. *Slimonia acuminata* (restored) ; the letters refer to the same parts as in *Eurypterus remipes*.

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THE MINUTE STRUCTURE OF THE VINEGAR PLANT.

BY HENRY J. SLACK, F.G.S.,

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Among the minute organisms which puzzle the microscopist the Vibrions and their relatives present great difficulties as regards their structure and classification. Ehrenberg assigned an animal nature to the whole family; but it is far more probable that all are, as some are known to be, vegetable, and perhaps rudimentary conditions of more highly organized plants. In *Pritchard's History of Infusoria* (fourth edition, p. 187) the results of Cohn's investigations are cited, and we find it laid down by that naturalist that "the Vibrionia apparently all belong to the vegetable kingdom, for they exhibit an intimate affinity with undoubted Algæ." Dr. Burnett is also quoted in the same place to the effect, that "their cell structure and their vital (not voluntary) motion would lead us to infer that the Vibrionia are algous plants, and not animals. This throws light on several common phenomena. One in particuiar is that the Vibrionia should almost invariably be found in infusions and liquids that contain other Algæ, and especially the common Torula; for I do not remember to have seen the Torula without Vibrionia."

It affords more precision to regard Algæ and Fungi as distinct classes of the sub-kingdom *Thallophytes;* and the Torula, with which Dr. Burnett found the vibrions associated, is ranked among the Coniomycetous Fungi, and is closely connected with the Yeast and Vinegar Plants.

It is not an easy question to define what is a vibrion, because minute bodies more or less divided into beads may differ widely in their origin, their properties, and their destination. In decomposing solutions objects of this kind invariably appear, and the researches of Pasteur, which are recorded in former numbers of the Intellectual Observer, and which I, therefore, shall not quote at length, lead to the conclusion that all kinds of fermentations and putrefactions are acts correlative with the growth of these remarkable organisms; and that their life, so to speak, presides over the decay and disintegration of higher animal or vegetable beings, and of the complicated products which they form.

Minute, and usually colourless, thread-like bodies of beaded structure, exhibiting a wriggling or oscillating motion, and destitute of organs (for the alleged filament of bacterium is probably a mistake), are readily recognized as belonging to the vibrion family; but the motion, though a common property,

does not seem an essential characteristic, and we shall only follow good authorities if we admit quiescent objects, which have the same form and exercise analogous functions, as members of the same family.

The usual divisions of vibrions into genera and species, we apprehend, satisfy nobody. Some are larger, some shorter, some divide obliquely, some at right angles to the longer axis. Some are like miniature corkscrews, and so far resemble that pretty confervoid plant the Spirulina. These latter move spirally, and often with rapidity. Others twist and wriggle, others oscillate, and others stand still.

The *Micrographic Dictionary* provisionally places some vibrions among the confervoid Algæ, and probably all will be distributed between the Algæ and the Fungi, the latter seeming most likely, to the writer, to carry off the greatest number.

In *Pritchard's Infusoria*, p. 531, the genus Bacterium, of Dujardin, is described as characterised by straight slightly flexible threads more or less distinctly jointed, and *slow* in their movements. In the next page all the species are said to have an *active* power of locomotion. The activity of motion certainly does not afford ground for generic or specific distribution, and some that are active at one time appear to be quiescent at another. For convenience, Dujardin's division may be adopted, as founded upon external characteristics easily distinguishable in extreme cases, though liable to be more or less confounded in intermediate forms. According to this, first comes *Bacterium*, the description of which we have just cited. Then we have "*Vibrio*, either straight or flexuose, with a more or less vivacious writhing movement;" and then "*Spirillum*, having the form of a corkscrew, revolving on their long axes, oftentimes with great rapidity, but never straight." They are all small bodies; few exhibit the beaded structure with less than an amplification of 500 diameters, and some defy a power of 2000 linear, which leaves them extremely minute in length, as well as in breadth. Ehrenberg constituted six genera of vibrions; and Pasteur, speaking of them, says that they can all exist without free oxygen, and perish in contact with it, if nothing preserves them from its action.* To *Monas crepusculum* and *Bacterium termo* he ascribes the disappearance of oxygen from putrefying infusions, and then he tells us the vibrions appear and do their work as *ferments*, pulling to pieces the complicated organic atoms in a definite way. If this view should be confirmed, it may serve as the foundation for a natural division of the vibrion family: those which live in oxygen and perform one set of functions being distinguishable by action and habit, if not always by appearance, from those which perish in oxygen

* See INTELLECTUAL OBSERVER, Sept., 1863, p. 101.

and perform functions of a different kind. Bacteriums, etc., form a well-known pellicle on the surface of organic solutions, and this pellicle, as M. Pasteur tells us, is usually associated with moulds and mildews, an observation coinciding with the statement of Dr. Burnett that torula and vibrions are commonly found together.

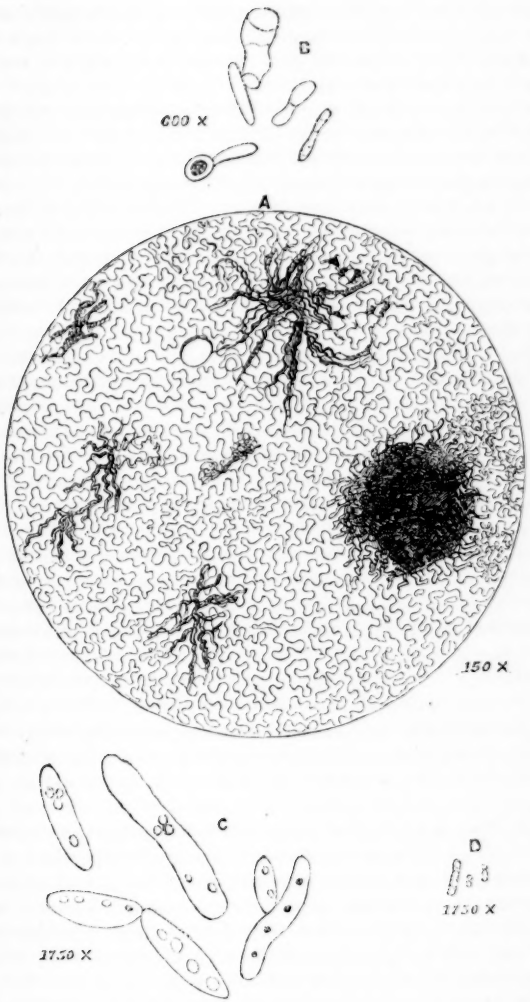
If we were to follow M. Pasteur in calling the "ferments of putrefaction" *vibrions,* we might call similar small bodies concerned in vinous or acetous fermentation *bacteriums;* that is to say, supposing we could connect such bodies with all processes of that sort, purely chemical ones excepted. When putrescence occurs in a liquid exposed to air, M. Pasteur represents the vibrions as determining changes in the body of the liquid, while the bacteriums and mucors burn the products of the vibrion action, and bring them back to the simple condition of binary compounds.

The INTELLECTUAL OBSERVER, vol. iii., p. 271 (May, 1863), contains another of M. Pasteur's papers, in which that distinguished investigator expresses the belief "that a considerable number of beings that can live without air determine different kinds of fermentation." Those without motion he calls *vegetable,* and those with motion *animal,* thus following Ehrenberg into untenable ground. In a previous paper, given in the INTELLECTUAL OBSERVER for September, 1862, "On a New Process of Vinegar-Making," the same author shows that the mycoderms of wine and vinegar act as agents for conveying the oxygen of the air to a crowd of organic substances; and in the still earlier paper (already cited),* he speaks of this oxydizing faculty as existing in various degrees among the mucedines, and also among the smallest of the infusoria, by which we presume he means members of the vibrion family. Are we not, from these facts, justified in considering that the oxydizing vibrion may be closely connected with the fungi of similar action? and towards this the minute structure of the vinegar plant points.

The *Micrographic Dictionary* observes that, from various observations, the vinegar plant may be regarded as the mycelium of *Penicillium glaucum*† vegetating actively, and increasing also by crops of gonidia, or gemmæ. It adds "that the moniliform growth is, at the same time, scarcely distinguishable from the yeast plant by any satisfactory character, and repeated observations strongly impress us with the idea that these objects are all referable to one species—the vinegar plant being the form of vegetative growth taking place at low or ordinary temperatures in highly saccharine liquids; while the

* See INTELLECTUAL OBSERVER, vol. i., p. 242.

† The *Penicillium glaucum* is the common blue mould.



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true yeast plant, or torula, is formed in the more rapid fermentation, taking place at more elevated temperatures."*

The vinegar plant, commonly so called, is a tough, leathery mass, often used by private families to make vinegar out of solutions of sugar and treacle; but the same plant exists in a more delicate and diffused form when other modes of vinegar-making are employed; and M. Pasteur shows that it coats the shavings, or twigs, over which some manufacturers cause a suitable liquid to flow when they desire to promote its acetification. If a thin piece of the large, tough vinegar plant is examined microscopically, a moderate power suffices to show what the *Micrographic Dictionary* describes; namely, an unorganized jelly and cellular structures of many shapes, often resembling coherent cells of yeast; others being like oïdium, etc., etc. It is also, in those I have examined, easy to see something like an entangled mass of minute threads; but, when this structure is carefully treated, myriads of bacterium bodies appear, and are found to constitute the chief bulk of the plant itself.

I am not aware that these bacterium bodies have been described before, and I will therefore explain the process by which I became acquainted with their existence. First a small, thin strip of the vinegar plant should be torn off from any part on or below the surface. This should be placed upon a glass slide, moistened with a drop of water, and stretched out by means of a camel-hair pencil-holder and the back of a penknife. When reduced by stretching and squeezing to a film not exceeding a 250th or a 300th of an inch thick, cover with thin glass, press steadily, and view with a high power, using the achromatic condenser and a small stop. An immense quantity of little thread-like bodies will then be seen; and, if the power be sufficient and the illumination carefully adjusted, a beaded form will appear sufficiently often to indicate the class of object to which they belong. That the little bacterium bodies have not been obtained by tearing big ones to pieces in the stretching process will be plain upon examination of the plant in different conditions of extension and thickness.

I have employed in this investigation Smith and Beck's $\frac{1}{20}$th and second eye-piece, giving a magnification of 1750 linear, with occasional resort to their first eye-piece, reducing the power to 1000 linear, or to their third, bringing it up to 3000. A minute drop of solution of iodine, followed by another minute drop of dilute sulphuric acid, facilitates the view of the beaded structure; but it can be made out without such aid when the eye has got used to the object, and the illumination is suf-

* This theory is doubtful, as the alcoholic fermentation goes on slowly and at low temperatures with the German sediment yeast.

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ficiently careful. I do not think all the little bodies are beaded, but conceive that they tend to become so, and I think the amount of division and distinction of one bead from another varies according to the stage of growth. The size of these bacterium bodies varies; thus, after examining portions of a large adult plant, I find entered in my note-book that large ones on that occasion were 1-8000" long, and small not half as much. On the same occasion it was with extreme difficulty I could make out a beaded structure in any of the bodies, while on others I saw it, as I find entered, in "scores."

Occasionally I saw bacterium bodies not distinguishable from those in the gelatinous mass, swimming close to the edge of the portion under examination; but I could not be certain whether they had been set free by the tearing and stretching, or whether they had never been embedded in the mass. I think, however, the former was the case.

After two or three fragments of a large plant had been undisturbed about a week in a Preston salts bottle containing water with a little sugar in solution, I found a thin, delicate new plant about one inch in diameter floating at the top. This, on being viewed with a power of 150, exhibited the appearance of the accompanying sketch, the dark threads consisting of strings of beads, apparently spores. Whether old or young, a quantity of larger cells will be found embedded in the gelatinous mass. Some of them (drawn from the young plant) are shown in the sketch, and will be found to contain smaller cells. These little cells (gonidia?) were sometimes isolated, sometimes approximated; and on one occasion I thought one of the larger cells contained two bacterium bodies, each composed of three or four beads. The position of the object was, however, unfavourable for determining this with certainty.

Mitsherlich's observations on yeast may throw light upon these cells containing spores or gonidia. He tells us that the *unterhefe*, or sediment yeast of the Bavarian beer, is propagated by spores thrown out from the larger cells, and not by buds or offshoots, as is the case with surface yeast.* I do not mean to assert that the large cells in the vinegar plant are yeast cells, although I think it probable; but, if not, they may be cells of the same plant in a different condition, and therefore requiring a separate name, although several conditions and several names may, after all, have to be grouped together as sub-names of a single species of plant.

The larger cells not only vary in shape and contents, but also in position; some are isolated, others collected in small associations, while in other spots hundreds are approximated in a more or less regular pattern.

* *Miller's Chemistry*, vol. iii., p. 105.

The bacterium bodies probably give rise to the tough mucus in which they are involved, and the unorganized mass in which they are embedded in the vinegar plant may only differ in density from the more delicate material in which the same kind of bodies are enveloped when they form a pellicle on the surface of infusions, or adhere in a more or less globular shape. On this subject the remarks of Dr. Arlidge, in the first part of *Pritchard's Infusoria*, may be cited with advantage. He says, "When we come to examine an infusion rich in these organisms, numerous jelly-like colourless masses of different size and figure may be met with on the walls of the vessel, and on the surface of the fluid. These, when young, resemble small balls, from 1—1000″ and less in diameter; but as they continue constantly to enlarge, they acquire a clustered outline, and exhibit themselves as colourless masses, and films of very considerable superficial dimensions and thickness, resembling soft palmellæ in consistence. Like these, they are composed of a transparent mucus, in which numberless punctate or linear corpuscles are embedded." Now, if we could make the mucus more dense and tough, multiply the "punctate or linear corpuscles" indefinitely, and introduce a sprinkle of larger cells analogous to those of the yeast, we should have a vinegar plant as its structure appears to me.

The yeast plant is shown, as already stated, to be intimately connected, if not identical with, several vegetable forms to which distinct names have been assigned; but, both upon botanical and chemico-physiological grounds, it would be very interesting to ascertain to what extent that form of it known as the vinegar plant is associated with bacterium bodies. It is not enough that in one or two cases we find quantities of these bodies present when alcohol or saccharine matter is converted into vinegar—the question is, are they always present, and do they seem to be the particular agents by which the vinegar-making is carried on. To ascertain this, the vessels of various sorts of vinegar works should be examined, and when the process is conducted by suffering a certain fluid to trickle over twigs or shavings, it should be ascertained whether bacterium bodies appear in quantity together with, or as a *component part of the Mycoderma aceti*, of which M. Pasteur speaks.

Omitting those cases in which vinegar or acetic acid results from purely chemical processes, such as the destructive distillation of wood, or the influence of spongy platina, it appears to be obtained by the action of vegetable ferments on saccharine matter or alcohol, neither of which can be present in *excess* without stopping the process. Certain other substances in small quantities are also required to be present, or the growth of the organic bodies cannot proceed. In Germany, where alcohol is cheap, vinegar is made directly from it. Large

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vats are fitted up with perforated shelves, on which a quantity of beech or deal shavings, first dried and soaked in strong vinegar, is placed. A mixture, consisting of one part of alcohol, sp. gr. 0·850, of six of water, and 1000th of honey, yeast, or wort, is allowed to trickle slowly through the shavings, while the temperature is raised to about 80° F. The acetification does not proceed rapidly until the process has been in operation for some days,* that is to say, until the vinegar plant has had plenty of time to grow. Spongy platina will oxydize alcohol and generate vinegar as the vinegar plant does, although probably not *precisely* in the same way; but, however, alcohol becomes changed into acetic acid, Professor Miller considers that the formation of aldehyd always precedes the production of vinegar by an oxydizing process, and he gives the following formula as expressing what takes place when alcohol is thus transformed :—

$$\overbrace{C_4\,H_6\,O_2}^{\text{Alcohol.}} + 2\,O = \overbrace{C_4\,H_4\,O_2}^{\text{Aldehyd.}} + 2\,HO\text{; and}$$

$$\overbrace{C_4\,H_4\,O_2}^{\text{Aldehyd.}} + 2\,O = \overbrace{HO,\,C_4\,H_3\,O_3}^{\text{Acetic acid.}}$$

When vinegar is obtained from a saccharine solution, the changes are more complicated; the cane-sugar is converted into grape-sugar, the grape-sugar into alcohol, and the alcohol into vinegar. Thus the vinegar plant appears to perform the double function of first alcoholizing and then acetifying the solution. Do the yeast-like cells accomplish one portion of this task, and the bacterium bodies the other?

The mycoderm of wine does not in its ordinary state give rise to vinegar. Its own vital processes merely supply the means by which the changes incidental to vinous fermentation take place, but it occasionally happens that brewers are greatly teased by the acetous fermentation of their beer occuring after the alcoholic change has finished. I have heard of several instances this summer in which great annoyance has been experienced from this cause, and it would seem either that spores of the vinegar plant were diffused to a greater extent than usual, or that portions of yeast remaining in the beer had developed into the vinegar plant form. M. Pasteur's view of fermentation does not coincide with the common statement that the yeast plant merely separates sugar into carbonic acid and alcohol—at any rate he does not represent that as the entire process, because he tells us that when experiments were performed in close vessels containing, besides the fermenting liquid, a known quantity of air, it was found that the vinegar plant took oxygen from the air, and therewith converted the

* *Miller's Chemistry*, vol. ii. p. 135.

alcohol into acetic acid, and that the mycoderm of wine converted the alcohol into water and carbonic acid. Thus both act as oxydisers, and it is well known that if the vinegar plant be left in a fluid after it has transformed the sugar or alcohol into vinegar, it then burns up the vinegar, and leaves the housewife, or other manufacturer, who has neglected to remove it at the right period, only dirty water for her pains. M. Pasteur also tells us that the vinegar plant cannot acetify when it is submerged, while, as the German *unterhefe* yeast proves, the wine or beer fermentation can be excited by a yeast plant at the bottom of the fluid. These facts suggest inquiries into the action of different portions of a thick vinegar plant, of which one part is always under the fluid.

It seems to the writer that Professor Graham's researches into dialysis afford a probable explanation of the actions of small plant cells in the cases adduced. Their delicate membranes give a preferential passage to one substance over another, and they may permit new combinations to be formed by allowing them the means of getting out of the way of those from which they were derived. They present oxygen to a compound, and if certain of its atoms choose to take it, they can escape with the new object of their chemical attachment. Thus the process bears some resemblance to the decompositions effected in water when that fluid allows the new resulting compound to fall as a precipitate, or escape as a gas.

M. Béchamp states that acetic acid is one of the products of vinous fermentation, and the fact is accepted by M. Pasteur. M. Maumené disputed it, declaring that all well-made wines contained no acetic acid. This brought a rejoinder from M. Béchamp, to the effect that acetic acid is found even in the must of grapes. M. de Luca examined sixty-seven wines of Tuscany, and found acetic acid in all. M. Pasteur found that if a small quantity of vinegar was introduced when the *Mycoderma vini* was growing in an alcoholic liquid in contact with air, it disappeared, and he never obtained acetic acid from the growth of that plant in a liquid of this kind. These facts seem to show that the vinegar plant is present in all alcoholic fermentations, and exerts *some* action, although the chief and prevailing action is that of the *Mycoderma vini*, which is antagonistic to it, notwithstanding its analogous character.

Here I leave the question for the present. I have brought forward certain facts which I think important, and many conjectures which may stimulate inquiry, if they are not of any other use. The subject is within the reach of thousands of microscopists who habitually read the INTELLECTUAL OBSERVER; and I shall be much obliged if any of them will favour me with any new information they may collect.

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THE DICRANUMS, OR FORK-MOSSES.

BY M. G. CAMPBELL.

About thirty species of Fork-moss are ascertained to be natives of the British isles. These, by strongly marked distinctions of foliage, naturally divide themselves into two groups, with the generic appellations of Dicranum and Fissidens.

As six of the Dicranums are in fruit during the month of November, we will confine our attention to them for the present. They are named from *δίκρανον*, a forked instrument, in allusion to the cloven teeth of the genus, and are perennial plants, growing on rocks or on the ground, sometimes on the trunks of trees, in tufts more or less dense and extensive; the stems varying in height from a few lines to several inches; the smaller species not much unlike the Weissiæ; the larger, among which are some scarcely surpassed in size by any other of the acrocarpous division of mosses, in some instances bear considerable resemblance to the *Trichostoma* and *Cynodontium*. The leaves are usually somewhat lanceolate, spreading, or secund, *i.e.*, all turned to one side, the reticulation variable, usually small, dot-like or roundish in the narrower part of the leaf, elongated, narrow, and often wavy lower down, at the marginal base considerably enlarged, quadrate, and tinged with colour more or less deeply. The calyptra cucullate, with a long beak; the lid conical at the base, with a long beak, slender oblique, and varying in length. The peristome single, consisting of sixteen equi-distant teeth, which are confluent at the base, and cloven half way or more into two unequal portions, the medial line being continued to the base with occasional perforations. They are also marked with transverse bars, prominent on the inside of the tooth, and surrounded externally with a somewhat rigid membrane of a red or orange colour. The spores are rather small and of a reddish brown tint.

The most commonly met with is *Dicranum heteromallum*, or the Silky-leaved Fork-moss. It grows in extensive silky patches upon moist banks, the stems tufted, or matted together, simple or branched, with crowded secund leaves, somewhat bristle-shaped and slightly dentate at the apex, of a silky appearance and with a flattened nerve, which forms the chief part of the upper portion of the leaf, giving

it the bristly appearance, and passing insensibly into the broader laminar substance of which the lower part of the leaf is composed. The capsule is cernuous, or sometimes sub-erect, obovate, gibbous, uniformly coloured of a reddish brown, with a somewhat, but never distinctly, strumose neck; the lid conical at the base, and tapering into a long beak, sometimes, but not always, with the reaping-hook-like curvature towards the extremity, as given in the illustration, which is a magnified representation of a specimen gathered from Ferny Hills, Nailsworth, where it seems to grow much more diminutively than in most other places, the usual height assigned to this moss being about an inch, while the specimens from Ferny Hills do not reach one-fourth of that measurement. The seta or fruit-stalk is slender, of a pale yellowish colour, and rather long in proportion to the plant. When dry and empty the capsule is slightly and obliquely furrowed, by which character and by the pale seta Wilson says it may always be distinguished.

In *Dicranum pellucidum*, or the Transparent Fork-moss, the leaves instead of being secund are squarrose, and variously bent. In form they are lanceolate from a slightly sheathing base, rather obtuse, entire, serrated or crenulate at the apex only, papillose on both sides, especially at the back and along the nerve, slightly undulated in the margin, keeled, and twisted or crisped when dry; and as *D. heteromallum* is found in patches of a deep, though bright green, *D. pellucidum* on the contrary grows in patches of a light green colour, from one to two inches high. The capsule is seated on a rather thick and wavy pale fruit-stalk; it is usually sub-cernuous, but in one variety erect, always roundish, shortly ovate or oblong, with thick firm walls of a reddish brown, becoming at length blackish, and destitute of a struma. The teeth of the peristome are variable both in form and markings, sometimes but very slightly cloven, and sometimes with prominent bars. The lid is large, conical at the base, with a longer or shorter oblique beak, always much thicker than in *heteromallum*.

D. pellucidum grows on wet rocks and stones in shady rivulets, and loves the spray of cascades.

Dicranum Schreberi, or Schreber's Fork-moss, grows also in light green patches, but the stems are only from half an inch to one inch in height. It is also found by rivulets or ditches, on sandy or clayey soil, but is regarded as rare. The inflorescence of all three is dioicus, the barren flower being terminal on a separate individual.

The leaves of *D. Schreberi* are widely spreading, and flexuose; from a broad sheating base they suddenly contract into a narrowly lanceolate, or lanceolato-subulate form, denticulate in the margin near the apex, with a nerve ceasing below the

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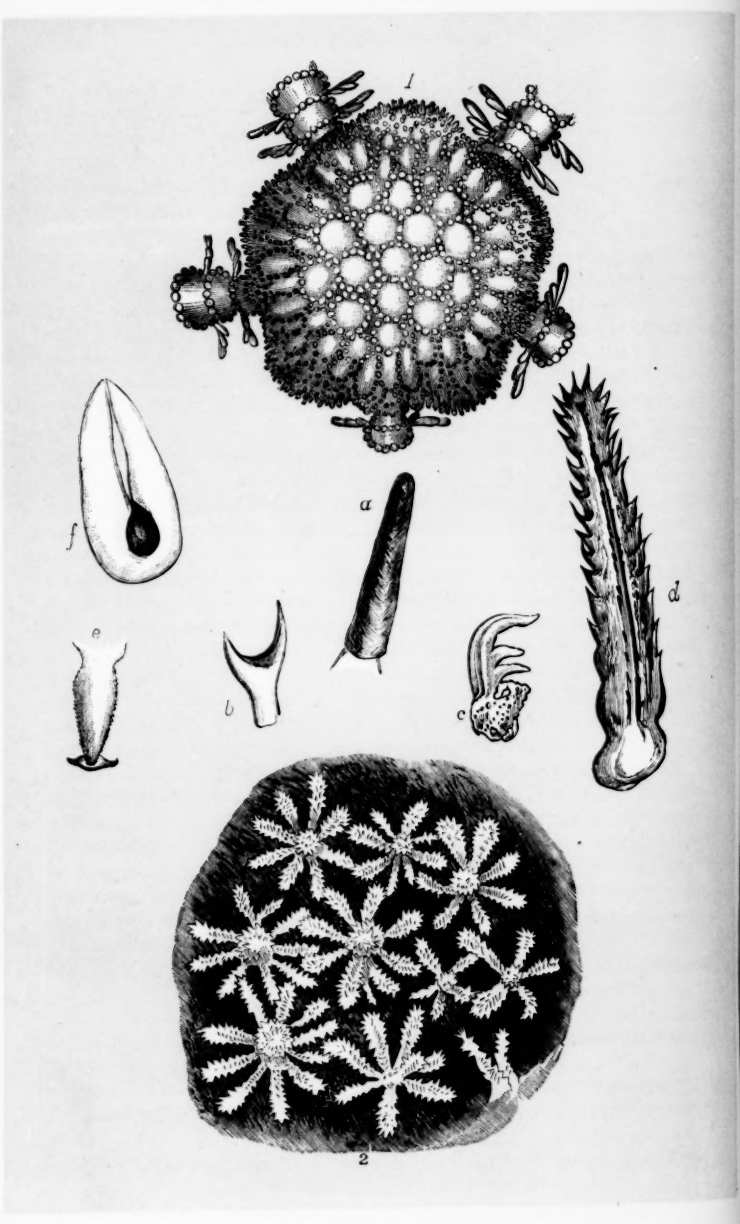
point. When dry they become slightly crisped. The perichætial are larger than the others. The capsule, like that of *heteromallum*, is cernuous or sub-erect, but in form it differs in being shortly ovate, regular or slightly curved, and having a large lid but shortly rostrate, about as long as the capsule.

Dicranum crispum, or the Curl-leaved Fork-moss, is found in incoherent patches of a green colour; the stems not half an inch high, and scarcely branched. It grows on moist banks in a sandy soil, but is not common. The leaves are not much crowded, widely spreading, wavy and subulate, with a suddenly dilated sheathing base, somewhat glossy and minutely denticulate, the nerve forming the principal portion of the upper parts of the leaf. When dry the leaves are crisped. The capsule is borne erect on a reddish fruit-stalk, ovate or ovate-oblong, not strumose, but having an annulus, and furrowed when dry; the lid is conical at the base, as in the rest of the genus, with an oblique awl-shaped beak. The plant is sufficiently distinguished from its allies by the very narrow crisped leaves and erect striated capsule. The inflorescence is monoicus; the barren flower shaped like a small bud.

In the variable Fork-moss, *Dicranum varium*, the inflorescence is dioicus, the stems short, cespitose, or loosely aggregate, of a rufous green colour, scarcely half an inch long. The leaves are more or less secund, lanceolate, carinate, and entire or slightly toothed at the apex, the margin reflexed, nerve sub-excurrent, the perichætial leaves scarcely sheathing, and hardly differing from the rest. The capsule varies from ovate to oblong, more or less oblique and incurved, slightly tumid at the base, its walls thick and smooth. The fruit-stalk twists to the right; the lid is large, with a short beak. The peristome is large, deeply cleft, and of a deep red colour, the teeth converging. No annulus, and the barren flowered plants are more slender than the fertile ones. Soil and locality make considerable difference in this, one of the commonest species of the genus. Habitat, moist banks.

D. rufescens, or Reddish Fork-moss, has also a dioicous inflorescence, with short gregarious stems scarcely branched, sub-erect, bright red; leaves almost pellucid, lax, secund, reddish, linear lanceolate, with plane margins, obscurely toothed and loosely cellular. The capsule is erect, smooth ovate, reddish, with a short neck; the lid large, with a short beak; the fruit-stalk twisted to the left. The teeth of the peristome are more closely barred than in *D. varium*, and it is altogether a more elegant moss; this circumstance, joined to its colour, at once distinguishing it, though found in similar spots. All the above species are found in fruit during this month, and it is hoped the above descriptions will suffice to render them easily distinguishable.



1. Disk of Ophiocoma bellis (magnified.)
2. Part of ray of Luidia fragilissima (magnified.)

THE BRITISH STAR-FISHES.

BY GEORGE S. BRADY, M.R.C.S.

(*With a Tinted Plate.*)

It is not at all the object of the present paper to give any general account of the natural history of the Star-fishes, but simply to notice a few points in their structure and economy which may be interesting to the general reader, and especially to the microscopist. And to be easily intelligible we must first briefly describe the external structure and configuration of the creatures to which we refer.

The sub-kingdom Radiata of the older naturalists is now, in accordance with the results of recent investigation, broken up and reconstituted. The fundamental idea of a radiated structure was, however, so far as mere external appearance went, correct enough, and no better type of such an organization could be desired than that supplied by the common Star-fishes. Each Star-fish consists of a central disk, from which are given off symmetrically, like the spokes of a wheel, the arms, or to speak technically, the rays. These rays are mostly five in number, but in some species seven, twelve, or thirteen may be observed. The common Sun-star (*Solaster papposa*), one of the largest and handsomest, as well as one of the most common species, has usually thirteen rays; while the still commoner *Urasters*, found everywhere between tide-marks, are examples of the five-rayed form. The number *five* is, so to speak, the key-note of the class Echinodermata, and may be found in all parts of their external organization, continually recurring either singly or in multiples.

The under surface of a Star-fish exhibits a central orifice, which acts both as mouth and anus; and diverging from it on the under surface of each ray is a longitudinal space or "avenue," furnished on each side (except in the *Ophiuradæ*, Sand-stars and Brittle-stars, where moveable spines take the place of suckers, and in which the "avenues" are absent) with innumerable retractile suckers or feet, which serve as organs of locomotion. The Star-fishes are divided according to their mode of locomotion into Spinigrades, moving by means of spines—Cirrhigrades, by suckers—and Pinnigrade, by fins or pinnæ. Of the last-named division we have only one British genus, *Comatula*, concerning which some remarks will be found toward the end of this paper. At the very extremity of each ray is an organ like an eye, having spinous appendages, which are termed the eyelids. It is doubtful, however, whether these parts have really any visual endowment; no proof of their possessing the faculty of sight has ever been advanced, and from

what we know of the nature of this sense generally in the lowest forms of animal life we should be disposed to consider that the organs in question must serve some other as yet unknown purpose. Other animals not far from the Star-fishes in general organization, though possessing, so far as we know, no special visual apparatus, are yet extremely sensitive to light, and this sensitiveness seems to consist of a nervous irritability shared by every part of the body, higher in degree, but possibly of a nature somewhat analogous to that of similar manifestations observable in plants.

The upper or dorsal surface of the Star-fish presents appearances differing very considerably in different genera. It may be perfectly smooth; it may be rough with tubercles or bristling with spines, and it is the various forms of these appendages to which we wish at present specially to devote our attention. The genera *Ophiura* and *Ophiocoma* (Sand-stars and Brittle-stars) may be easily recognized by the great length and tenuity of their rays, and their excessive fragility. The whole surface, both of disk and rays, is covered by scales which are so closely appressed as to give an almost perfectly smooth surface. These scales are arranged in definite and often in very beautiful patterns, and in some species the primary scales are edged or encircled by series of circular bosses or tubercles, giving an exquisitely "rosulated" aspect to the disk and rays. An example of this is given in Fig. 1 of the tinted plate, which is a representation of the disk and bases of the rays of *Ophiocoma bellis*. Though the surface of the disk is in mature individuals of these genera mostly smooth, many of them are when young closely beset with spines, and in some cases these are persistent even in mature age. The disk of *Ophiocoma Goodsiri* is not unfrequently thus clothed. Its spines are represented at *a* in the tinted plate; *b* of the same plate illustrates the spines, which cover the disk of young *Ophiocoma rosula*. The rays are in these genera constantly provided with numerous spines which serve as locomotive organs, differing, however, very widely in length and strength. *Ophiocoma filiformis* has its spines frequently tipped with curious anchor-shaped processes (fig. *e*), which are supposed to facilitate the motion of the creature over the muddy bottoms which it frequents. In *Ophiura* they are very short, and not apparent without careful inspection; while in *Ophiocoma* they are so long as to give quite a bristly, spinous appearance to the animal, being sometimes, in fact, very much longer than the breadth of the rays. The gradual development of the spines of *O. rosula* has been carefully studied by Mr. Hodge.* In their early stages they are armed with hooks at the extre-

* *Transactions of Tyneside Naturalists Field Club*, vol. v., p. 41.

mities, but by successive deposits of calcareous matter at the base of the spine, the hooks are constantly pushed forwards and finally obliterated. They are, however, occasionally observed in mature specimens, and in cases where a rejected limb is in process of reconstruction. Fig. *c* in the woodcut is copied from Mr. Hodge's illustration of the "hooks" of young *Ophiocoma rosula*, and Fig. *d* represents one of the spines of an adult specimen. The common "Cross-fishes" (*Uraster*) of our coast have a reticulated surface, set with lines of short, but sharp spines: these differ in length and strength according to species. In *Uraster glacialis* they are very strong, and arranged in well marked ridges. In this genus are constantly noticed the peculiar appendages termed *Pedicellariæ*, of which we shall have more to say further on. *Cribella* has a non-reticulated surface, but in lieu of the network and spines is covered with small tubercles mostly irregularly arranged. About these there is not much to interest the microscopist.

Among the largest and handsomest of British star-fishes is *Goniaster equestris*, the Sea-pincushion, as it is called by our northern fishermen. The appellation is not inapt, for the large fleshy mass of the animal is covered thickly with round bosses or tubercles of the size of a large pin's head. Each of these is encircled at the base by a series of smaller tubercles, generally from twenty to thirty in number. Interspersed among the tubercles over the whole upper surface, but still more numerously beneath, are certain pincer-like organs, composed each of two flattened lips or valves, which fit together accurately, and which during the life of the animal may be seen in constant motion, opening and shutting, so at least say the fishermen. I have never myself seen the creature alive. I do not, however, doubt the fact. Dr. Johnston states that the radiating circles of spines of *Luidia* (described further on) have the power of voluntarily opening and closing in a similar manner; and he also noticed the same phenomenon in the present species. These pincers are likewise surrounded by circles of small tubercles. The pentangular disk and rays are bordered by a double row of flattened plates, each of which bears three or four large tubercles, and is encircled by a series of minute ones in the same way as the simple tubercle of the disk. The elaborate ornamentation and great size of this species make it a very desirable addition to the cabinet. It is often brought in in considerable numbers by the trawlers on our north-eastern coast, and specimens not unfrequently measure ten or eleven inches in diameter.

A striking contrast to this large and fleshy species is *Palmipes membranaceus*, the "Bird's-foot Sea-star," which is almost as thin as parchment, and might, as Professor Forbes

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says, be readily mistaken for the torn-off skin of some bulkier species. Its surface is covered with slightly elevated tubercles, which bear very closely-set fasciculi of short and sharp spines. It is one of the rarest of our native forms, being altogether an inhabitant of deep water, and is mostly found very much denuded of its spines.

Asterias aurantiaca and *Luidia fragilissima** present a surface structure very different from any of the species previously noticed, their tuberculated epidermis being so closely set with upright spines, as to be almost wholly invisible. These spines are arranged in a radiated or rosette-shaped manner, and have a roughened surface. A portion of the ray of *Luidia* forms a microscopic object of exquisite beauty: it is represented in Fig. 2 of the tinted plate. The excessive fragility which characterizes many star-fishes is in no instance better shown than in *Luidia*. Forbes gives the following graphic account of the capture of one of them, probably off the coast of the Isle of Man:—"It is the wonderful power which the *Luidia* possesses, not merely of casting away its arms entire, but of breaking them voluntarily into little pieces with great rapidity, which approximates it to the *Ophiuræ*. This faculty renders the preservation of a perfect specimen a very difficult matter. The first time I ever took one of these creatures, I succeeded in getting it into the boat entire. Never having seen one before, and quite unconscious of its suicidal powers, I spread it out on a rowing bench, the better to admire its form and colours. On attempting to remove it for preservation, to my horror and disappointment I found only an assemblage of rejected members. My conservative endeavours were all neutralized by its destructive exertions, and it is now badly represented in my cabinet by an armless disk and a diskless arm. Next time I went to dredge on the same spot, determined not to be cheated out of a specimen in such a way a second time, I brought with me a bucket of cold fresh water, to which article star-fishes have a great antipathy. As I expected, a *Luidia* came up in the dredge, a most gorgeous specimen. As it does not generally break up before it is raised above the surface of the sea, cautiously and anxiously I sunk my bucket to a level with the dredge's mouth, and proceeded in the most gentle manner to introduce *Luidia* to the purer element. Whether the cold air was too much for him, or the sight of the bucket too terrific, I know not, but in a moment he proceeded to dissolve his corporation, and at every mesh of the dredge his fragments were seen escaping. In

* *Luidia fragilissima*, Forbes, is now sub-divided into two species, *L. Sarsii* and *L. Savignii*, the one having five and the other seven rays. The two species, however, present no structural differences.

despair I grasped at the largest, and brought up the extremity of an arm with its terminating eye, the spinous eyelid of which opened and closed with something exceedingly like a wink of derision." It may be added, that even had the Professor succeeded in "introducing *Luidia* to the purer element," it is very probable that his expectation of procuring a perfect cabinet specimen would not have been realized, for fresh water, though it mostly seems to paralyze and kill star-fishes instantaneously, thus preventing their breaking up, does not act so favourably on *Luidia*. The creature may be put at once into cold fresh water, and will lie there for some time breaking itself to pieces. The only way in which (so far as I know) this can be avoided is to press the disk of the animal forcibly down with the hand until it is dead. In this way its destructive contractions may be prevented.

The cirrhigrade star-fishes are furnished with certain curious appendages, the use of which is at present very imperfectly understood. These are the "*pedicellariæ*" and "*madreporiform tubercle.*" The latter is a rounded, cushion-like eminence of considerable size, situated on the disk, mostly very much out of the centre. It is irregularly fissured in a radiate manner, and is not at all unlike the animal from which it derives its name. It is found to communicate beneath with a short canal, which is connected with the vascular system of the star-fish. Various conjectures have been made as to the use of the madreporiform tubercle. It has been supposed to act either as a secreting organ for the calcareous elements of the animal, or to filter out the impurities of the circulating fluid. Professor Forbes looks upon it as being merely the analogue of the stalk which exists in the young condition of the crinoid star-fishes: if this be really the case it must be considered as a rudimentary organ without any specific function. The *pedicellariæ* are pincer-like organs which are irregularly scattered over the surface of the animal, and which have distinct characters in the different species. They were for long supposed to be parasitic creatures, but are now generally admitted to be true epidermic appendages. They are in constant active motion during the life of the star-fish, and grasp firmly anything which is brought between their blades.* Their nearest analogues are the birds'-head processes which occur in certain zoophytes, and which Mr. Gosse believes to serve the purpose of seizing organic matters, and by holding them in their grasp to provide food for the animal in an indirect manner; for the decomposition of the captured morsel in time attracts round it clouds of infusoriæ, which are swept into the stomach of the polyp by its vigorous ciliary action. It is needless to say, that although

* One of the pedicellariæ of *Uraster rubens* is shown at *f*, in the woodcut.

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the pedicellariæ of Echinoderms are somewhat similar in appearance, they cannot be supposed to perform a like office in animals so well endowed with locomotive powers, and so voracious in their attacks upon creatures almost as large as themselves, such as oysters and other molluscs. Star-fishes are, indeed, held to be the most destructive enemies of oyster-beds.

We must not conclude our paper without some notice of the Feather-star (*Comatula rosacea*), perhaps the most interesting of British star-fishes—one which is unique in the gracefulness of its form and the exquisite beauty of its colouring, whose life-history is very remarkable, and which possesses the additional interest of being the only living representative in our seas of the group of organisms so familiar to us in the fossil state as *Encrinites*. The delicate structure of this species renders it impossible to preserve it satisfactorily in a dry state: it is only when exhibited in some preservative fluid that any idea can be formed of the elegance of the living animal. The central cup-shaped body gives origin to five rays, which divide so near the base as to appear like ten. These are furnished throughout their length with membranous pinnæ or fins, with which the creature swims freely. It is said to propel itself somewhat in the manner of a medusa, using its arms alternately, five of them being in action while the other five are quiescent.

In the year 1823, Mr. J. Vaughan Thompson (whose name will be held in lasting remembrance as the discoverer likewise of the metamorphoses of the Crustacea), found in the Cove of Cork a creature about three-quarters of an inch in height, resembling very much a minute feather-star set upon a flexible, articulated stem. This he described and named *Pentacrinus Europæus;* but in 1836 he published a second paper in which he announced his discovery that the *Pentacrinus* was but the young state of *Comatula,* and this opinion is now held by all zoologists. Mr. Thompson found all his *Pentacrini* attached to Zoophytes, but they have been taken by others amongst Fuci, though never upon stones or shells. The larger *Comatulæ* are mostly met with in deep water, being taken by the dredge; and it would appear that they come into the shallower water near shore for the purpose of depositing their ova in the littoral groves of Zoophytes and Laminariæ. The development of the animal from the ovum, through the pentacrinoid stage to the mature form of Comatula, has never, I believe, been watched uninterruptedly: the feather-star has not yet been caught in the very act of leaving its encrinital stem, but for all that, the facts which *have* been observed, though they rather invite than preclude further investigation, are amply sufficient to place this most interesting episode of animal life beyond the doubt of any but the most inveterate sceptic.

CLUSTERS AND NEBULÆ. OCCULTATIONS.

BY THE REV. T. W. WEBB, M.A., F.R.A.S.

THE lover of system may perhaps have felt disposed to take exception to the arrangement of our little catalogue of Double Stars, and with some justice, from his point of view. Large and small, close and wide, conspicuous and difficult, were all intermingled in the greatest apparent disorder. This, however, was deliberately done, on the ground of the observer's convenience; the intention not having been to provide a classified catalogue, but a familiar guide to the amateur through each successive month. A similar apology, or, at any rate, explanation, is even more requisite at the commencement of our present list, since the objects we shall enumerate are yet more dissimilar from each other, and will be arranged in a manner still more unlike systematic classification. The difference is extreme between a coarse group of bright stars visible even to the unaided eye, and a faint and almost evanescent haze, whose stellar nature depends upon inference alone, or possibly may be liable to suspicion. The reader, however, will find them all here, arranged merely to suit his convenience: and possibly he may not be displeased with the resulting effect of variety and contrast. It should also be borne in mind that though the comprehensive title "Clusters and Nebulæ" is more appropriate than either designation would have been separately, it indicates in many cases a distinction without a difference; nearly all clusters that are visible at all with the naked eye appearing to it as nebulæ, and an increasing proportion of telescopic nebulæ being resolved into clusters as we increase the aperture of our instruments. The boundary-line has an actual existence in every telescope, when it ceases to recognize individual points of light in the haze; but it is different in different instruments, and it has no existence in nature,—or at any rate the question of its existence is one of the most perplexing, as well as most interesting, points in modern astronomy,—and therefore any arrangement which pre-supposes a definite separation, must needs be, in the present state of our knowledge, merely arbitrary.

Our commencement will be a glorious one. We shall take up first an object, the very finest perhaps of its class in our latitudes—

I. *The Cluster in the Sword-hand of Perseus,* in astronomical symbolism 33 $\overset{\circ}{\mathrm{H}}$ vi., that is to say, No. 33 in Sir W. Herschel's list of "very compressed and rich clusters of stars," which form the sixth class in his celebrated catalogue. Being obvious to the naked eye as a nebulous spot of some extent, or rather, with 34 $\overset{\circ}{\mathrm{H}}$ vi., as two contiguous nebulæ, this will be

immediately found in the galaxy between *Cassiopea* and the principal stars of *Perseus* (see INTELLECTUAL OBSERVER, xi. 373). Even small telescopes will here disclose a scene of wonder. Smyth has described it as a brilliant mass of stars, from 7th to 15th mags., filling the whole field of view, and emitting a peculiarly splendid light. In the centre, he says, is "a coronet, or rather ellipse, of small stars, above an 8th mag. one. . . . The 7th mag. star which follows is handsome from the blackness of the space immediately around it. . . . This is followed by another gorgeous group of stars from the 7th to the 15th mags. at about 3^m, and nearly on the parallel. It is 34 H vi. The components gather most towards the centre, but there is little disposition to form; the sprinkle, however, is in a direction parallel to the equator. One of the central individuals is of a fine ruby colour, and a 7th mag. in the *n f* is of a pale garnet tint, with two sparkling but minute triplets south of it. These two clusters are quite distinct, though the outliers of each may be brought into the same field under rather high powers; and, on the best nights, the groups and light are truly admirable, affording together one of the most brilliant telescopic objects in the heavens. It is impossible to contemplate them and not infer that there are other laws of aggregation than those which obtain among the more scattered and insulated stars."

If these clusters are, as Sir W. Herschel thought, a protuberant part of the Milky Way, and if magnitude is not a wholly fallacious guide as to distance, the splendour of their components, as compared with the average minuteness of the individuals which make up the feeble light of the galaxy, would indicate that they must be very much nearer to us than the general situation of that zone, and that this region must consequently be the foreshortened projection of a long irregular stream of stars, whose direction is towards the spectator. The whole of this district is truly magnificent. Whoever would gain an extended idea of the infinite riches of the Creator's handiwork, may find it in sweeping over this, as well as many other portions of the galaxy, where He has literally

"Sowed with stars the heaven thick as a field."

Our second object will be one of an entirely different character; less brilliant, indeed, but mysterious in the highest degree:—

II. *The Great Nebula in Orion.* Beneath the lowest, or most easterly of the three gems of Orion's belt, we see a depending line of smaller stars, forming the *sword*,* one among

* In 1807, the University of Leipzig formed a new constellation out of the belt and sword of Orion, to be called by the name of *Napoleon*. What a melancholy, but instructive, instance of human weakness!

which, having a more hazy aspect than the rest, will be recognized at once as a nebula by the naked eye in a clear night. It is singular, therefore, that it should not have been included among the "nebulosæ" of the ancients; and still more singular that Galileo, in making the earliest telescopic delineation of this region of the sky, including the very stars in question, should have missed it; for small as his instrument was, it was abundantly adequate to disclose to him a marvellous appearance in the midst of them. We can only suppose that he may have mistaken it for the effect of moisture upon his eye-glass, but if so, his examination must have been a very cursory one: and this, indeed, we should deduce from the roughness of his sketch, unless, as is so frequently the case, engravers and copyists may have been in fault. The first notice of it which has been found is a correct though incidental description of it by Cysatus shortly after, who compared with it the telescopic aspect of the grand comet of 1618. Huygens, not being aware of this, announced it in 1656 as a discovery, the like of which he had not been able to observe anywhere else among the stars, and sketched it roughly with a power of 100 in his 23 feet refractor. His impression was that no telescopes but his would show it; a curious example of the amount of self-deception which may result from unchallenged success, for we cannot imagine that the object was less visible to the naked eye then than now. He saw, however, as it appears, only three of the stars in the trapezium, which forms so conspicuous a centre-piece; the 4th was added by Picart in 1673.* It was natural that so remarkable an object should attract much notice, and many descriptions and figures by the earlier astronomers are extant; but for want of optical power their results are of little value. Sir W. Herschel figured it in 1774; it was the first object viewed with his 40 feet reflector in 1787; and he gave another design in 1811: Schröter represented it in 1794; Sir J. Herschel in 1824, and again at a greater altitude and in a clearer sky at the Cape of Good Hope in 1837; and among other modern observers, the Earl of Rosse, Lamont, Lassell, Bond, Liapounov, Struve, and Secchi, have directed much attention to it. Notwithstanding the magnificent instrumental means and unquestioned ability brought to bear upon it by these great astronomers, their representations are not altogether accordant, and, generally speaking, they are not fully satisfied with each other's work. There must indeed be always a margin of uncertainty left as to these ill-defined and cloudy patches; and Sir J.

* Arago says, by Dominic Cassini; but without reference: and this seems improbable, as Mairan, who gives the exact date of Picart's discovery (March 20), makes no mention of Cassini's. Picart's observation remained, however, in MS. till 1731. Cassini died in 1712.

Herschel has cautioned us that "very great differences will occur in the descriptions of one and the same nebula taken on different nights, and under different atmospheric circumstances, as well as in different states of the mirror and the eye; nor will it at all startle one accustomed to the observation of nebulæ to see such an object described at one time as faint, small, round, and at another as bright, pretty large, pretty much extended, resolvable, etc.;" but after making every allowance on this score, as well as for the great difficulty of representing such an object well, it must be admitted that the variations are more considerable and perplexing than, considering the character of the observers, we might have expected.

Are we then thus forced upon the supposition of actual physical change? Such an idea would be sufficiently astonishing, when the enormous magnitude of so remote an object is considered; but it has been seriously entertained. Herschel I. had been led to suppose it fully established, from the disappearance of a misty envelope round certain stars adjacent to the nebula, and from an alteration in the direction of one of its branches; and though his son had at one time come to the conclusion that there were no differences which would not admit of explanation upon the grounds already mentioned, and that there was no reliable evidence of change, he subsequently felt obliged to alter his opinion, from the dissimilarity between his own designs in England and at the Cape; other discrepancies he could account for, from practice and a superior instrument and climate; but as to one part, he says, "it seems hardly possible to avoid the conclusion of some sensible alteration having taken place. No observer now, I think, looking ever so cursorily at this point of detail, would represent the broken, curved, and unsymmetrical nebula in question . . . as it is represented in the earlier of the two figures; and to suppose it *seen* as in 1837, and yet *drawn* as in 1824, would argue more negligence than I can believe myself fairly chargeable with." This would be indeed most weighty testimony, even if it stood alone; but such is by no means the case. In 1852, Lassell, after observing the nebula carefully with his 24-inch speculum, says, "a comparison of Sir J. Herschel's, Mr. Bond's, and my own drawings of this wonderful object must, I think, suggest the idea of change in the nebula, or variability in the stars, or otherwise a less uniformity of delineation of the same things than might have been hoped for." In 1856 W. Struve was led by the observations of Liapounov, who had during four years been most scrupulously measuring and delineating the nebula at Kazan with a $9\frac{1}{2}$-inch achromatic, to infer that it may be subject to changes of form and relative brightness in its different

parts. The year following, a very minute and continuous examination of the central portion with the great achromatic at Poulkova induced O. Struve to entertain the impression that the light of its several parts was in a state of perpetual change. Even with the best definition, he says that its appearances were to him on no evening entirely agreeing with those on the next or any other night, and he points out several spots as open to the greatest amount of suspicion, adding, however, unfortunately we fear for our readers, that for the greater part such changes in the gradation of light can only be seen with very high optical means, and would require as much as ten inches of aperture, unless in extraordinary states of the atmosphere. D'Arrest, the Copenhagen observer, who is paying especial attention to the subject of nebulæ, and in a manner which promises most satisfactory results, thought, in May 1862, that these variations, especially the bridging over of the large dark opening with a misty filament, were the first established facts with regard to the variability of nebulæ.

But should any of these suspected changes be deemed sufficiently ascertained, we see at once on what a marvellous field of speculation we have entered. Hitherto we have been assuming that all nebulous appearances are, what the majority unquestionably are, nothing but the light of excessively remote and closely compacted masses of stars. But greatly as our power of belief has been enlarged by the study of sidereal wonders, it still remains inconceivable that any aggregation of stars could possibly experience such changes either of form or brightness as we should thus be compelled to admit. We cannot imagine a multitude of suns thus displaced collectively through distances, which upon any reasonable computation must be of enormous extent; no known force exists to which such a result could be ascribed; and the idea of simultaneous variation of light affecting uncounted individuals is equally inadmissible. Are we then sure that our original inference is in this instance correct? Is that misty brightness composed of stars at all? Is it not possible that it may be merely a luminous haze, as Halley had surmised long ago, of exceeding tenuity, and therefore capable of receiving impulses, which, however obscure their origin may be, would yet imply no such irreconcileable contradictions to all our experience? And have we not in comets, especially if they are conceived to be self-luminous (and the contrary has not been proved), an instance of a material exactly of such a nature? Ideas of this kind had gradually opened themselves to the mind of the great discoverer of the nebulæ and their starry composition, the elder Herschel; and in 1811 he announced this essential change in his earlier views. He had once supposed that even the most irresolvable or "milky" nebulæ

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were all aggregations of stars of incalculable remoteness; but he had subsequently found bright stars so accurately centred in circular haze, that it was most improbable that the effect should be due to a mere perspective projection of the one upon the other; he had noticed other instances of nebulæ whose shape seemed remarkably accommodated to the position of stars, which must have been, it would seem, actually not optically adjacent; he had ascertained that the great nebulæ in Orion and Andromeda, brilliant enough to strike the unaided eye, and whose starry nature ought therefore to have been most apparent of all, were utterly irresolvable even in his gigantic telescopes; he had noticed in the former of these the combination of the brightest and the faintest nebulosity, and hence perceived that, contrary to all his former conclusions, "the range of the visibility of the diffused nebulous matter cannot be great;" and from an extended comparison of a series of circular irresolvable nebulæ, in the separate individuals of which central condensation and brilliancy gradually increased till it assumed a star-like character, he concluded that we thus had before our eyes at once the whole process by which a thin luminous haze is compressed into a flaming sun. This was the basis of the celebrated "Nebular Hypothesis," which in the hands of Laplace assumed such an extended development, and professed to account for not merely the creation of suns from self-luminous mists, but the formation of planets from rings of nebulous matter dropped off from these suns during the process of condensation, and of satellites in turn from the planets as they shrank into solidity. To some minds, speculations of this nature, however visionary, are so attractive that they become insensible to their attendant difficulties; others, on the contrary, incapable perhaps of originating such theories, are much more sensible of their weakness. However, the hypothesis in the present instance, as we have seen, was not without plausibility, and it seemed to rest on a substratum of something like fact, so long as the telescopes of Herschel I. were unrivalled in that light-grasping power which is so essential in these researches. But an appeal lay to the future; and the results of that appeal, while they have shaken rudely the foundation, have but introduced additional mystery. Schröter had suspected that his 18-inch speculum was beginning in some spots to approach the resolvability of the nebula; but his skill in this kind of observation was not great, if we may judge from the figure he has given. Herschel II. found it impracticable with a similar aperture in 1824. Lassell, with his magnificent 24-inch mirror, had no hope, in 1847, of the absolute resolution of even the principal part; and the purer skies of Malta, in 1852, and a power of 1018, did not enable him to break up the "wool-like

masses" in the slightest degree. But it was reserved for the Earl of Rosse, the constructor of the optical colossus of the age, to make known that in the spring of 1846 he "first perceived the brighter portions of the nebula of Orion in the neighbourhood of the trapezium breaking up into minute stars." It had been repeatedly examined with his 3-feet mirror in vain; but, according to the Herschelian maxim, that when an object has once been discovered, inferior instrumental means will show it afterwards, some of the individuals could be subsequently detected on very fine nights with that telescope also. Sir J. Herschel, in the superior air of the Cape, considered that its granular texture evidently indicated its starry nature. Bond, with his $14\frac{3}{4}$ inches of achromatic aperture, found that the components were "separately seen for a moment under favourable circumstances." Secchi, like De Vico before him, thought that the Cauchoix achromatic of $6\frac{1}{3}$ inches showed twinklings and unequivocal signs of resolution in the clearest evenings (but those were Roman evenings), and, subsequently, with the $9\frac{1}{2}$-inch Merz and a power of 1000, these bright points were more steadily seen. Now what are we to think of all this? or how are these seeming contradictions to be reconciled? Nothing seems to be absolutely demonstrated on either side; but admitting all the modern observations to be of equal weight, we may perhaps be drifting towards the supposition that the minute granulations into which those cloudy masses seem decomposable may not after all be stars, in the usual sense of the word; or that, as Secchi thinks, the brighter portions may consist of stars, while the fainter may be of another nature, and actually situated, as indeed Herschel I. had suspected, even nearer to us than some of the bright stars with which they seem connected. We may never be able to unveil the whole mystery, but it is reasonable to hope somewhat from the future. Larger telescopes are called into existence every year; and the result of Lassell's re-examination at Malta with his 4-feet speculum has not, it is believed, been made publicly known. He stated, in January 1862, that he saw so much more of its wonderful constitution as to feel the necessity of drawing it afresh; but his expressions, founded it is true upon a cursory view in not the most favourable circumstances, do not imply great hope of resolution; in fact he was "surprised, perhaps disappointed, not to see many more new stars." His final report will be received with the greatest interest.

The well-known trapezium has been already described as No. 93 of our list of Double Stars. The addition of the 5th star by W. Struve occasioned much surprise, the group having been so often studied before, through a long series of years, with telescopes fully competent to have shown it. Sir J. Herschel

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is confident that it was not there when he made his first drawing in 1824, and re-examined it 1826, March 13, in a perfectly clear air, in company with Mr. Ramage, the celebrated maker of large specula. Nov. 11 of that year, Struve saw it in full moonshine: 1827, Nov. 16 and Dec. 16, Herschel found that it could not "be overlooked but by wilful inattention:" the following March he found that it had greatly diminished. It may very probably be variable, as Smyth supposes. As far back as 1664, only two years after the Royal Society had received its charter and its name, Hooke communicated to it that he had "found those stars in Orion's belt which M. de Zulichem" (*i.e.*, Huygens) "maketh but three, to be five." This seems vague; but as the original figure of Huygens shows only one group of three, the trapezium is probably meant; and if so, the 5th must then have been far more brilliant than at the date of any subsequent observation. At present, it forms a good test for object-glasses of moderate size; though less serviceable than if it attained a greater elevation. Dawes saw it with a 5-feet achromatic; but this gives little encouragement to ordinary eyes. I have repeatedly seen it with $5\frac{1}{2}$ inches, lying a little outwards from the line joining the two *n p*, or fainter stars. The effect of $14\frac{3}{4}$ inches of light may be estimated from the fact that, though rated 13 mag., this little point has been seen by the American observers *after sunrise*. A more difficult object is a 6th, yet minuter star, discovered by Sir J. Herschel with Sir J. South's $11\frac{3}{4}$-inch object-glass, and considered by him to have only about $\frac{1}{3}$ the light of the 5th. It lies, according to Dawes, but 2″·79 from the brightest, or most southerly, of the four old ones,* and consequently requires a superior instrument to be cleared from its rays. The remarkable fact pointed out by Sir J. Herschel, that "the apparent inequality of two stars seen at once in the same field of view diminishes as the light of the telescope is greater," and which, he justly adds, "ought to be always borne in mind when the comparative magnitude of stars is under discussion," is curiously illustrated in the case of these minute points, which Lassell found both equally bright and easily seen. He calls them even *brilliant!* Such was the light even of his old 2-feet speculum under the Maltese sky. Probably No. 6 may be variable, for Struve could never see it at Dorpat, and Secchi missed it on one occasion, though the atmosphere was beautiful; and yet Lassell had at one time thought it even larger than 5. Dumouchel and his successor De Vico added three more stars, but Sir J. Herschel could not find them, and the Cauchoix achromatic at Rome was known to have a bad habit of pointing out little *comites* that had no existence. Porro, however, the Paris

* Bond's drawing, by some oversight, makes the *f* star the largest of all.

optician, speaks of having seen two of them, and added a fresh one in 1857 with his enormous object-glass of 21¼ inches, about which such conflicting opinions have been expressed, and so little seems to be really known. This last may, perhaps, be the star discovered also by Lassell in 1862. It, appears, however, from the researches of Otto Struve, that other minute stars in this region show variable light; a circumstance, as he remarks, sufficiently singular in connection with their position in the central part of this wonderful nebula; and whatever fault may be justly found with Schröter's figure, on comparing it with those of Herschel and Bond, I am inclined to think that it points to the same conclusion. It has been noticed, as far back as Pond's day, that the interior of the trapezium is comparatively free from nebulous matter; and this does not seem to be a mere effect of contrast: on the other hand, an isolated star lying N. of the mouth of the great dark gulf was discovered by Mairan in 1731 to be encompassed by a haze, and has continued so ever since. The whole extent of the nebulous glow appears very considerable; much greater, from its undefined character, than might at first be supposed. By giving a rapid motion to his telescope, so as to induce the effect of contrast, Secchi has succeeded in tracing it through a space which may be described as roughly triangular, with a base of nearly 4° and a height of more than 5½°, reaching from its apex at ζ *Orionis*, with a break about σ, almost as far as υ; and a great part of this feeble light has been perceived by Goldschmidt with a little telescope of not much more than three inches aperture. A special investigation by the present director of Harvard University, the son of the late W. C. Bond, into the arrangement of the more luminous portion, has induced him to conclude that, notwithstanding its apparent confusion and real intricacy. it may be decomposed into a number of curved wisps or wreaths, of which he has distinctly traced about twenty, indicating a spiral structure, similar to that which the Earl of Rosse has detected in so many nebulæ, and which has been repeatedly found associated with a stellar constitution. Secchi also observed a spiral curve around one of the stars.

This summary of modern discoveries has extended itself to a length for which it is hoped that the exceeding interest of the subject may be a sufficient apology. It is to be regretted that the amount of optical power required for these researches is not likely to be at the disposal of many of our readers. They need not, however, be altogether discouraged. My comparatively small aperture shows sufficiently well the peculiar appearance which Lassell has described as masses of very light clouds, packed one behind another, their edges being very light and filmy, so that the sky is evidently seen through, or like little

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thin carelessly-scattered masses of cotton-wool; and the only observation which I have had during the present season, and the first in which I have paid much attention to the nebulous light (October 6th, less than two hours before the remarkable earthquake), was a very satisfactory one, as I saw distinctly, with various powers, without previously knowing its situation, the "bridging over" of the *Sinus magnus*, or great dark opening, by a feeble filament, more distinct in the middle, with an occasional suspicion of a star there; and I even perceived, what at the time I had no idea had been previously noticed, that the portion of the gulf thus included was less dark than the interior, the reverse of what is shown by Bond, but, as I have since found, agreeing with the observations of Secchi.

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November 19, κ *Piscium*, $4\frac{1}{2}$ mag., will disappear at 12h. 12m., and reappear at 13h. 9m. The observation will be favourable from the size of the star, and the approach of the dark limb of the moon, and unusually interesting from the occultation, only 4m. later, of 9 *Piscium*, a 6 mag. star. 30th. 60 *Cancri*, 6 mag., will be hidden from 10h. 33m. till 11h. 37m.

BOTANIZING AT OAKSHOTT HEATH.

BY SHIRLEY HIBBERD.

Oakshott Heath is almost a *terra incognita*. It has no place in "Bradshaw," and many of the folks who live within rifle-range of its black slopes and furze-fringed hollows have not yet inhaled its pleasant breezes. *Murray's Hand-book of Surrey* takes the tourist round its outmost borders, on the way to Walton, but keeps it all a secret that there is such a place as Oakshott, and of its name *Black's Guide* is equally silent. It is not at all strange that Oakshott should hide itself from public gaze, and keep its seclusion sacred among the shadowy pine woods, for it has attractions only for the lovers of scenery and the collectors of plants. There is no Hall with quaint carvings and old pictures—no village with Gothic or Norman church—no inhabitants even but stag-beetles and small, lean kine, which vanish at nightfall no one knows whither, and reappear at daybreak to browse on moss or rushes, for there is scarcely a blade of grass to be found over hundreds of acres. If you examine the map of Surrey, you will observe that there is a chain of hills stretching east and west from Rochester to Guildford, thence to Ash, then north to Bagshot; thence north-east to Egham, and again due east to Kingston. These hills mark out the prime parts of Surrey, and when London botanists and pleasure-seekers are at a

loss where to go next for fresh air, fine scenery, and the choicest examples of the British flora, let them select any town or village in this range of hills, and having made the transit thither by rail or road, they may be sure of finding pleasure if they care to seek it. But supposing the reader to have explored these hills throughout, he will probably know but little of Oakshott; he will have shot past it, or round it, somehow in his wanderings, and the better for him, for there is a happy experience in reserve—a real sensation; and if he takes Oakshott last instead of first, the Surrey hills will be dealt with fairly: but it would be unfair to go to Oakshott first, because after feasting on its beauties, many more famous spots on this range will be found very tame by comparison. While the map is spread out, it will be as well to mark out the site that now interests us. The Epsom branches of the South-Western and South-Eastern Railways terminate at Leatherhead, almost in the centre of the long range of the Surrey hills. A little to the south of Leatherhead, the land rises higher and higher towards Dorking, and on the nearest of the slopes is situated the princely estate of Claremont, of which Oakshott is but an unimportant waste, producing scarcely fodder enough to keep one donkey. We have been botanizing about Leatherhead and the surrounding hills occasionally during the past six months, but as our botanizing was mixed up with serious matters of business, we rarely got more than glimpses of the floral treasures that abound here, and determined to put business aside for a season, and pay court to Flora only. Self and friend took train on the 28th of September for Leatherhead: arrived at Leatherhead at dusk, walked along the new road to the right of the station, past Prince's Cover, direct to Oakshott. Here found at the "Brown Bear" inn a party of rustics, eighteen in number, prepared to eat a supper of boiled beef, roast mutton, and plum pudding. Joined this party, partook of the generous fare, made speeches, and next morning started early to the heath. If my reader intends to take the same route, the "Brown Bear" is to be recommended, not for any elegance of the bear itself, for it is a somewhat rugged animal, but because of its nearness to the scene of action, and the certainty of finding the heath from this starting-point. We start, provided with vasculum, basket, and provender, for we shall not enter a human habitation till nightfall. We are armed with knives, pocket-lenses, good temper, stout sticks, and waterproof boots, but anticipate no dangers but such as properly belong to steep hills and treacherous bogs.

We take the road, and our first halt is at a bend to the left, where, as the land falls directly before us, we have a grand view of the country to the north and east. Far across the hills lies Hampton Court, to the right of that Kingston, and further on

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to the right rise the towers and nave of the Crystal Palace at Sydenham, a grand spectacle seen from this point, glittering in the morning sun. Here we make our first find, two feverfews, *Chrysanthemum parthenium* and *C. inodorum*, close together, smothered with fresh flowers, and smiling a welcome in the hedgerow. Immediately opposite is a steep bank, from the summit of which is obtained the best view of the country, and under that bank grow *Lastrea filix mas, oreopteris,* and *dilatata*. But we proceed on our journey, passing a grand cover, which is entered by a gate on the right hand, and where there is a wilderness of ferns and ericas that we dare not look at, or we shall never get to Oakshott. We now approach a landmark; it is a school-house on the right-hand side of the road, and here we turn off to the left into a quiet country lane. Friend avers that in a coppice to the left of this lane there are some grand specimens of fungi; so we commit trespass, cross a meadow, and are soon in the coppice, which at first sight appeared to be paved with pheasants. When these grand personages had made way for us, with a clatter of wings among the ash-poles like the first outbreak of a party of beaters in a wolf country, we found the place paved with ground ivy, violets, common species of veronica, geum, ajuga, primroses, and buttercups, most of them in bloom, and everywhere abundance of funguses. We bagged *Agaricus cecilia, A. rachodes, A. vaginatus,* the very beautiful *A. fusipes,* and a fine specimen which we could not determine, but apparently intermediate between *A. personatus* and *A. nudus*. It had a solid stem, but the pileus was brilliantly coloured. With the exception of the fungi we saw few plants here of any interest, and were soon on our way again back to the lane, and forward towards the heath. The banks in this lane are, however, worth examination. On one side the soil is dry and has plenty of sun, on the other side it is moist and shaded. On the sunny side there are half a dozen species of hawkweed and other gay composites, on the shady side common lastreas, grand festoons of bryony, and rich beards of chickweed smothering tufts of primula. The road presently bends to the right and we recognize one of the good botanical stations, here called "Wapping Dock," consisting of a bank and cover on the right hand, and a substantial farmhouse and corn-ricks on the left. Here is the first proof that we are near the heath, for the soil of the bank is peaty, and on the bank there are a few stray tufts of ling and erica, and all the succulent and leafy plants looked starved. Here we found *Hieracium pilosella,* still showing bloom, and mostly smooth-leaved and stunted; *Apargia hispida,* the rough hawk-bit, starved down by drought and poor soil to a most delicate character, and claiming to be regarded as one of the most

elegant of alpines. *Apargia autumnalis* was here also in several forms, its gay yellow starry flowers sparkling like gold amid its tufts of dark green deeply-lobed leaves. *Senecio sylvaticus*, the mountain groundsel, and *S. tenuifolius*, the hoary ragwort, were scattered sparingly on this bank, and an unmistakeable tuft of emerald green proved to be the pretty *Sagina procumbens*, the properest of all plants except *Spergula saginoides* for fairies to dance upon. Wapping Dock opens in some sort of way, very mysteriously, on the heath. You have to wind about a sort of geographical corkscrew of lanes, banks, and bits of waste; but it is impossible to miss the way, for you have before you a prospect of pines flanking a broken waste as black as the shores of the Tyne in the neighbourhood of Newcastle. Of course we make our way in the direction of this uninviting scene, and presently forget its solemnity by tumbling into the midst of a wilderness of brake and blackberries. Nature is very kind to botanists. We see before us a savage wilderness, but we enter it by way of a lovely dell, where the brake rises like palms over our heads, the dwarf furze, *Ulex nanus*, is smothered with its golden flowers, and the blackberries present their sooty clusters, all glistening with ripeness, and we taste the sweets of civilization before encountering the bitters of solitude. There is a weird wildness in the scene we are entering upon; behind us are a few cottages and farms, before us miles of silent waste, populated to the extent of about one squirrel, one lean heifer, and one stag-beetle to the square mile. Rabbits and foxes appear to abound, for their burrows are plentiful; but as they are all in their subterranean retreats, they cannot count among the daylight population. But we are very pleasantly invited onward by the configuration of the country. Right before us lies a deep dry gully, forming the winter drain and boundary to a broad belt of pine and hornbeam that stretches away in front, and only ceases at the vanishing point in the landscape. From this gully the land rises rapidly to the right and carries the eye upward to the summit of a dark cone, almost as regularly formed as a sugar-loaf, but more obtuse in proportions. The sides of this gully would suffice us for more than one day's botanizing. The soil is white sand, deepening into black peat on the surface, and the vegetation is such as we find only in connection with sand, and peat, and pure air, and utter neglect by man. Nature has dressed these wilds in her own way, and now their principal decorations are huge and curious fungi. On every hand along the course of the gully and down in its dry bed, they are scattered with wonderful profusion. In some places you can scarcely step without crushing their flaky heads and pulpy stems, and here and there some monstrous Bovista or

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Boletus has subsided in decay, and looks like a wet leather saddle or dilapidated knapsack. Here are lovely clusters of the little green-beaded and stripe-stemmed *Leotia lubrica*, the elegant dove-coloured *Dædalea quercinus* on fragments of dead wood, and an immense number of species of Agaric. But the grandest funguses here are *Boletus edulis*, which here grows to an immense size, and the brilliantly coloured and very poisonous *B. luridus*, with dark dull brown pileus, and vermilion and orange stem and tubes, the last presenting a most elegant reticulation when viewed through a pocket lens. We found also *B. luteus*, *B. versipellis*, and *B. scaber*, and one small specimen of *B. variegatus*. Presently afterwards, at a point where the fungi became less frequent, some grand clusters of *Agaricus longipes*, their broad shields supported on slender stems like lances, and at least half a dozen distinct degrees of grace amongst them, and a brilliantly coloured fungus which we took to be *Boletus purpureus*.

For the sake of a change we came up out of the gully, and encountered a herd of about twenty jet black pigs which had stealthily followed us from the village expressly to ascertain who we were, and what we were about. The leader, a splendid hog, promising to be fit for bacon at Christmas, advanced to very close quarters, made a few sniffs and gruntings, and then turned and led the herd back at a terrific gallop, satisfied we supposed with their scrutiny, and not a little alarmed at the ugliness of the people they had thus made acquaintance with. To tell the truth, we were almost as much frightened as the pigs, for when we went down into the gully there was not so much animal life anywhere visible or within hearing as would cover a sixpence; and after digging and shouting, and scrambling for half-an-hour, it was something of a surprise to come face to face with these negroes, all their moist snouts thrust forward, and the old baconer in advance, all eager to see and smell the botanists and the prizes. As the pigs scampered back, as if their tails had been singed, we trudged up the cone to make our first halt upon its summit. Now we began to feel we were on the heath; no more blackberries, brakes, or fungi; the whole extent of the hill side, and as far on all hands as could be seen, was a mingled mass of lichen, moss, dodder, and heath. Instead of walking on coal or flint, or any other hard or black material, the ground was almost snow white with lichen, which covered the entire surface from the base to the summit of the cone; through the lichen sprang ling and heath in such profusion that it was difficult to discover how the lichen could make so distinct a feature in the colouring, especially as much of the heath was still in bloom, and here and there made lovely sheets of rose, purple, and lively red.

We toiled on till we reached the summit, and there we sat down on the edge of a large saucer-like hollow of which the summit consists, and drank in the crisp breeze, and felt for the first time the grandeur of this solitude. And it is grand. The heathy slope looks as forbidding as the grave as you enter upon it, but changes to the luxuriance of a flowery cushion, into which the foot sinks deliciously, when it is reached; and after being shut in by the towering wall of Scotch pine on one hand, and the steep dark slopes of the heath upon the other,

LICHEN, LING, AND DODDER.

the sudden expansion of the view on gaining the summit has an effect of that freshening and inspiriting kind that we feel on quitting a sick-room after a night's watching, to taste the breeze that comes with the rising sun, when the wild song of the thrush mingles with the delicious melody of the nightingale. Now there is much said about fine views, and I know a few of them. Friend knows a few also, but self and friend agree that the view from this cone is worth a journey of a hundred miles. On all sides there is a distinct boundary of green hills, forming an almost sharp circular basin, in the centre of

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which, on a lesser hill, we stand and shout to the heath and the sky, and our admiration and our shouts are lost over such an expanse of open country that there is no echo. Below runs the dark line of firs, which leading onward to the wilds, seems interminable, and over their heads and through their few thin narrow gaps we catch sight of hills similar to those which skirt the horizon elsewhere. On the north, the fir woods darken into gigantic blotches, and seem at last to shrink away in the distance, as if in that direction they purposed to encompass the world. Eastward lies London, and we can just discern the cloudy canopy that overhangs it, as if it were blessed of heaven with a precious fall of dew, though we know but too well what that cloud is: it is the coal smoke that would kill all this lichen and heather in a week were it wafted across them as it hovers there to kill mankind instead. Now we can just catch sight of the towers of the Crystal Palace peeping over the line of a slight depression in the dark horizon, and as the eye travels towards the south, we see the lovely fir woods of Esher; then farther to the south the lands swell up richly and roundly, as if Dame Nature had bared her full bosom to the heavens to show that it still has the beauty of youth and the plenty of maturity. This grand swell drops down, and immediately another and a nearer hill rises, and where the slopes of the two approximate in the line of vision, their conjuncture forms a broad letter V on the horizon. That letter V gives the key to Box Hill, and from thence, as the eye travels towards the west, a glimpse of Guildford is obtained, and beyond that, when the atmosphere is clear, the view opens far into Hampshire, and little gray dots and indigo lines, and dust-like gleams of gray and brown, indicate the hamlets and woods and chalky hills of one of the loveliest counties of England. The air was balmy, the sun warm, and the barometer high when we started on our journey; here we found the air so bleak and the breeze so brisk, that one of the two had to light a pipe to ward off a twinge of tic, and when this was done we rolled about, and friend, the elder and more serious of the two, could only be brought back to botany by the question, "Does the dodder ever make roots in the earth?" Thereupon friend began to dig, and at last turned up a huge bunch of peat, lichen, ling, and dodder, and with great dexterity proceeded to anatomize the mass, the result being that a single thread of dodder might be traced almost any distance, round and round, in and out, up and down, and by a hundred true-lover's knots, through the wiry ling; it could never be traced to the earth, but it was frequently found to have thrust its suckers and formed clusters of those red bulbous points among the lichen, though no true root could be found. I can remember finding the roots of dodder twenty years ago, but that was early

in the season; and there is no doubt the root perishes as soon as the parasitic stems have got firm hold of furze, heath, clover, or any other plant on which it is wont to feed. Twice this season I went over parts of this same heath when the dodder was in bloom, and a marvellously lovely sight it was to see the ground surfaced with the lichen, then over that the crimson

THE SUN-DEW, DROSERA ROTUNDIFOLIA.

gauze of the dodder loaded with its minute but showy red blossoms; above that again the deep green and glowing crimson of the ling, and in every hollow the crimson sun-dew, in such profusion as to appear nearly as rich as the ling in its heyday. Now we found the same strange association of lichen, ling, and dodder, but the ling had parted with its full glory, the flowers

were for the most part withered and white, though there was still enough bloom to make many a dazzling patch and streak of colour. In one of our previous visits we had seen but not gathered the great dodder, *Cuscuta Europæa*, and we made a search for it now, but in vain; *C. epithymum* abounded on every hand, and in some places covered breadths of ground of more than a rod in extent so densely as to constitute a rich red matting, through which the ling struggled, and not in vain. It was like quitting a banquet after only smelling the viands, when we started once more on our journey; we felt we could not feast to our fill on this lovely spot, but a journey was resolved on and a journey must be made.

We retraced our steps towards the gully and followed its course, diverging from it only to return again. Met with *Juncus squarrosus* in all sorts of shapes, once mistook it for a tuft of spergula, and once for a tuft of *Festuca ovina*, but always determined it without trouble, for in all its states it carried fruit, and though position altered its appearance, it seemed to luxuriate equally in wet hollows as upon the driest of the sandy slopes. As we push along in the direction of the gully, we find we are entering an incipient pine-wood. First we meet with little seedling pines of a few inches high, next larger specimens, now a cluster, next larger isolated specimens, and next fine masses, crowding thickly and threatening to kill out those that are in the thickest of the mass. The ground is gradually acquiring a spongy character, rushes increase, and the heaths change their character, the dodder disappears, and so does the lichen. The ground gradually acquires a rich carpeting of verdure, sprinkled all over with the blossoms of the heath, and we discover that we are approaching what we may call the garden of Oakshott, a land of luxury as regards its floral products, but needing waterproof boots, for the dry gully has changed to a full watercourse, the hill to a hollow, and we are entering upon a vast bog, densely crowded with luxurious vegetation. We continue our course, still following the boundary of the Scotch firs, the seedlings of which are forming another forest on these wet parts of the heath, and at last we make our second halt beside a large black pool, which soddens the ground for a vast distance all around, and is visibly connected with extensive tracts of real bog beyond. Here we find ourselves surrounded with wonders and curiosities, which it would require weeks to explore effectively. Here is a little dark green gem with minute blue flowers. What is it? It proves to be *Polygala vulgaris*, the common milkwort. Next we discover masses of an apparently scrophulaceous plant, which proves to be *Scutellaria minor*, quite a gem among the trifles of the bog. Next we observe that wherever there is a

tolerably clear space of wet black earth, the bog pimpernel, *Anagallis tenella*, has covered it with its tiny horizontal stems and fresh green dot-like leaves; but it is out of flower, and we see only half its beauty. The next find is *Lycopodium inundatum*, in large tufts, deliciously green and in very luxurious condition. After placing a number of such things in the vasculum, and adding a few roots to the store in the basket for addition to our collection of living curiosities, we make a general survey of the scene, and are as much delighted with our feet reeking in the bog as an hour ago when we trod the dry sand and inhaled the bleak air upon the cone. The heaths have entirely changed their character, yet here are all the same species, *E. tetralix* with its lovely terminal umbels of soft rose-bells, *E. cinerea* with whorled racemes of purplish red, *E. vagans* with its crowded spikes of pink blossoms, and *Calluna vulgaris*, as fresh in bloom as in August, and of several shades of colour, from rich fiery crimson to deep dull purple. This was one distinct feature in the scene, the freshness of the flowers as compared with their comparatively faded condition on the dry bleak uplands. Next we observe that several spikes of pure white flowers were to be found on *E. tetralix* and *E. cinerea*, and then we discovered that we were not among a mere undergrowth of heath, for the plants had the character of specimens with distinct stems, freely branched and tree-like in all their characters. A specimen of ling measured three feet six inches in height, and specimens of two and a-half to three feet were plentiful on every hand, and these all in wet bog and deeply bedded among *Sphagnum*, *Lycopodium*, and innumerable mosses, lichens, and rushes. But there was yet another feature of this scene observable, and strange that we did not see that first. The rich colourings of the heaths were mingled with a general haze of deep orange, which we found to result from an immense profusion of blossom spikes—the blossoms now closed and the seed ripening—of the bog asphodel, *Narthecium ossifragum*, which after all is the prevailing weed here, and only escaped notice at first because it had passed its prime, and had ceased to glow with its bright shades of amber, orange, and gold. From this charming spot we departed reluctantly, with the vasculum and basket crowded, and our pockets wet with tufts of bog containing rooted plants which were to be taken home alive for culture in the garden.

Now we began to know something of the bog. The incipient wood thickened as we progressed along the boundary line, and we soon found that we were traversing the bed of a great boggy watercourse between two distinct forests, a sort of low channel, about 250 feet broad, consisting of a spongy surface of vegetation, chiefly rushes and aquatic grasses, and that at every

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step we were in danger of being drawn in to make items in the fossils of the bog when it shall become rock, or coal, or lignite, or what else in the far-off ages. For those who make a similar tour in the course here indicated we give the word to beware at this point. There can be no mistake about the locality, because the watercourse has all the appearance of a road covered with rank vegetation, but not a tree or bush anywhere to check the progress of a horseman. By some means we got across this spongy dyke to the second or outer pine wood on the right, which is only a few inches higher than the bog. We had seen one squirrel while traversing the gully, now we heard the wind roar like a cataract of water in the old pine wood, and for the first time we became painfully conscious of the absolute deadness (as respects animal life) of this vast region. We had travelled miles, and had not seen one bird, we had neither heard nor seen a bee, a wasp, a cricket, or a blow-fly; we had long ago left the land of rabbits and foxes; here there appeared to be no game, no vermin, no *fera* of any kind; the wind, tumbling like water through the tops of the trees in the old pine wood, played the part of chorus, and a melancholy chorus it was. The only object of interest in the course of a journey of about a mile and a half beside this watercourse, was to find among the pines several pretty clumps of *Salix prostrata*, which clustered up with the grace and luxuriance of honeysuckle. We found here a sprig of *Betula*, with nearly circular serrated leaves, but could make nothing of it, and there were no birches about to claim it as kindred.

I like a genuine unmitigated gloom, the blacker the better—if a little dangerous and silent enough to cause a feeling of despair all the better; it prepares one to sympathize with our fellow-creatures who have been shipwrecked, shut up in coal-mines, or left helpless in a lighthouse without oil or fresh water or bread, and the sea running mountains high, and defying all help from the creature. Self and friend knew something of gloom, silence, damp, and danger ere we emerged from the wood, and once more basked in the sunlight, and breathed the free air, with the visible heaven above us. Oh, how delicious was it to spring forward on to a dry sandy slope again, and to make away across the thymy hummocks to a brook skirting a boundary line, and there make a feast of blackberries, so large, so black, so luscious, that if I trust myself to tell the truth, nobody will believe me; so let it suffice that this brook (which you can easily find if you follow in our footsteps) is arched over with huge rods of *Rubus fruticulosa*, and the fruit is probably not to be equalled by any other district of Britain. And what a brook this is! It is a paradise for a botanist. Think of lady-ferns being the prevailing weed of the place, and so luxuriant in

growth that you are puzzled for a moment to know *what* they are. *Lastrea oreopteris* showing its delicate visage through fringes of all the wild and delicate things that grow on damp banks, and amongst them *Equisetum telmateia* in the wildest luxuriance, ready to furnish any number of whipcords, umbrella frames, and skeletons of wigwams for the fairies, and very elegant and indescribable tufts of herbage for the conservatory (at least in *ours*) next season, for we basketed roots, while friend pressed a good specimen in the vasculum. This watercourse presently joins another which crosses its path, and the two form one, which take their way somehow towards Harbrook Common. At the junction of these brooks there is an extravagant display of vegetable luxuriance. Of course, as the soil here is a fat loam, the pretty peltate-leaved *Hydrocotyle vulgaris* is the prevailing weed. That makes a pretty beginning. Now add to it *Veronica beccubanga*, still in full bloom; *Veronica officinalis*, full of bloom; *Viola palustris*, with leaves as large as crown pieces; *Callitriche verna* and *C. autumnalis* forming emerald green mats, in the swiftest and brightest current of the brawling brook; *Myosotis palustris* in plenty on the margins, hiding the mud with myriads of seedling plants, and *Juncus uliginosus* in a viviparous form, and looking at first sight exactly like *Spergula nodosa*, to which it has no more real resemblance than to a grape-vine or banana.

The united watercourses would serve to indicate the way to Harbrook Common if needful. But no direction is needed, for there it rises bluff before you, a flatter cone than that we traversed on the heath, and much more common-like, with great tufts of furze looking very black upon the tawny groundwork of sand and gravel. For the first time in all our journey we caught sight of a man, who presently disappears over the summit of the cone, and is afterwards seen by us in the character of a furze-cutter. We soon gain the summit and sit down on real grass turf amidst huge knolls of furze, *Ulex Europæus*, and discuss the sandwiches and ale which Mrs. Brown Bear has so liberally and carefully provided us with. After such a tramp what a flavour there is in round of beef, even bread is a delicacy; and if a man cannot then thank God for making everything beautiful in its season he must be "fit for stratagems and spoils," and properly a companion for the bats and owls. At Harbrook Common you are at one of the meeting points of civilization and savagery. To the east, the birthplace of refinement, are half a dozen farms; to the west the pine woods continue, and in that direction we hurry away. Once more we traverse ground covered with lichens and calluna, but there is no dodder, and true ericas are scarce. Geologists may study the substratum, for there are some consi-

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derable excavations whence sand has been dug for the gardens of Claremont. We push on through another incipient pine wood, which must have been long undisturbed, for in the cart ruts there are seedling trees now measuring six feet high, and some of them are full of cones, and have borne fruit for more than four years. It is perhaps five and twenty years at least since those cart ruts were formed, and during the intervening period no wheels have disturbed the silence there. Our way leads us through a region covered with pines of large growth. All around is one uniform spongy carpet of pine strewings, save where it is variegated with clumps of Boletus and other fungi, which are here not plentiful, but choice. Here we meet two young men who are employed in the gardens at Claremont, and they guide us to the "Black Ponds," which we had determined to see, even if we should have to sleep on the heather. After traversing a vast breadth of monotonous wood we saw at last the gleaming of water in the distance, and in due time parted from our guides, and sat down beside a lake of some five and twenty acres in extent, the first of a series, called the "Black Ponds." Most appropriately are these lakes named, and this, the first of three, is perhaps the blackest of all. The water is clear as crystal, and the chief source of supply to Claremont. Yet the lake has the appearance of a vast sheet of burnished steel, on which every shadow falls in jet black outlines, recalling the scene in that poem of Moore's which commences—

> "By that lake whose gloomy shore,
> Skylark never warbles o'er."

Is it the peaty character of the soil or the dense umbrage of tall pines by which the lake is enclosed, that gives it this peculiar character? Perhaps the two causes combined are sufficient, and the result is peculiarly interesting. We deposited our baggage beside a small building where a horse is occasionally employed to work a pump, which forces the water of the lake through pipes of some miles in length to Claremont, and then made the circuit of its shores. What a place for botanists! Here are lilies, sedges, rushes, potamogetons, alismas, hydrocotyle, aquatic ranunculuses; and the walk that encompasses the lake takes the visitor amongst magnificent specimens of Scotch fir, silver birch, the alder, holly, and willow; and among the hollies is a noble specimen, which admirably illustrates that poem of Southey's, on the accuracy of which there has been considerable debate, for it produces lobed and spiny leaves below, and smooth entire leaves above, and in some places both kinds of leaves are to be found on the same branch. Many of the aquatic gatherings here were of kinds met with before, but our eyes were soon arrested by large

sheets of a Lysimachia-looking plant which fills several of the great bays and inlets. We unanimously pronounced it to be *L. nummularia*. The patches were smothered with minute yellow dots, which looked like the remains of blossoms of that species. But when we got specimens we found them covered with terminal spikes of unexpanded flowers, which on dissection proved by the united stamens and one-celled berry a relationship to Androsæmum, and we soon determined the plant to be *Hypericum elodes*, which Smith describes as never opening its flowers except during sunshine. But the fungi abounding everywhere on the shores of this lake were the most distinctive and glorious features of the scene. To enumerate them would be no small task. We named a considerable number, basketed more than we could hope to carry, and saw myriads that were beyond our knowledge. Dozens of species that we brought home fell to pieces, and became offensive before we could find time to examine them with a view to determine the species. Of those recognized, in addition to species already enumerated, we saw examples of *Agaricus rubescens*, *A. excelsus*, *A. clypeolarius* in lovely rose and rufous tints, *A. granulosa* more than usual mealy in appearance, *A. equestris*, this also occurs in a hollow near where there has been a great fire in the wood, on the way from Harbrook to the engine house; *A. terreus;* the elegant violet coloured *A. nudus* growing very large and the pileus dividing vertically, as if cut with a knife from the circumference to the centre; *A. imbricatus*, *A. fusipes*, *A. laccatus* in several shades, from cœrulean blue to grey and dusty brown; *A. leoninus*, remarkably handsome, the pileus a brilliant orange red and large; *A. fasciculatis*, a very toadstool-looking species, with rufous cap and slender stem; the ill-looking *Coprinus atramentarius*, and the curious *Paxillus involutus*, with depressed pileus of a dull brown colour. We looked for *Agaricus longicaulis*, but without success. Of *Boletus* and *Bovista* the specimens were extravagantly abundant, and on the shore, nearly opposite the engine house, in front of the clump of holly, there was a group of *Boletus purpureus*, sixteen in number, the smallest measuring five inches across, the largest seven inches and a half. This group was the grandest sight we had seen in the whole of the journey. If the reader knows the species he will feel a quickening of the pulse with sympathy for me, and will not be surprised to learn that I was in such ecstacies that friend thought he would have to hold me down, for I literally danced with delight. Can you imagine that scene? The broad, black, still lake, looking blacker and stiller because of the delicate rustling of the tall clumps of reed and sedge—the grim and solemn pines as rigid as if cast in bronze, for there

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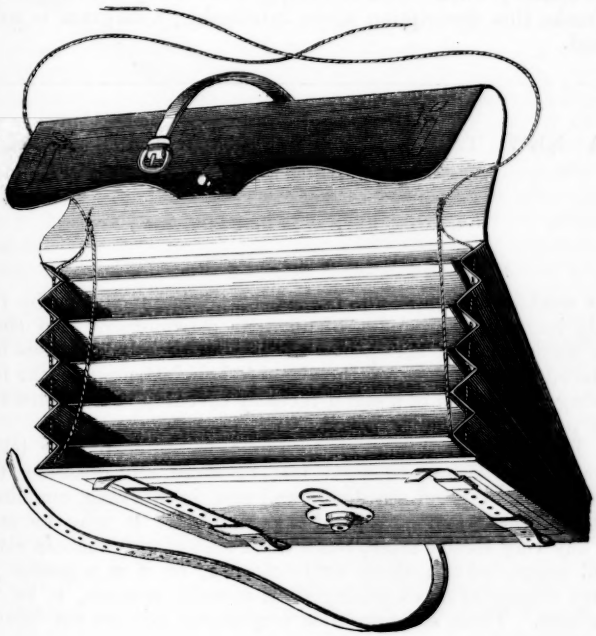
was not a breeze moving among their cloudy tops—the oppressive silence, for no bird whistled, no rabbit rustled, no beetle hummed. There was not one bright flower anywhere visible, and from out of the darkness of the shadows and the deep hues of holly and pine, these sixteen great disks of dazzling vermillion shot forth with the brightness and distinctness of the red lights seen at the head of an advancing railway train emerging from a tunnel at midnight. What huge things they were, with stout stems dotted with purplish red, with a network of greenish-orange pores beneath, that under a lens had the appearance of honeycomb, and their grand caps showing such a blaze of red, deepening here to purple, and there lighting up with a stain of orange, the most magnificent display of colour, I verily believe, it has ever been my lot to behold. Shall I say that mosses and lichens abound here? Of that the botanical reader may be quite sure, and as the season for collecting such things is near at hand, muscologists who read this work are by this hint forewarned and forearmed. I believe it will be found that the route taken in this journey presents as great a variety of mosses and lichens as any similar extent of land within at least a hundred miles of London.

Our tour may be said to have ended at the Black Ponds. We retraced our steps to Harbrook, then crossed over the hill, and made our way towards a white farm-house, which may be seen from the highest point of the common. Beside that farm-house stand two ancient elms, respecting which I have not been able to obtain any particulars worth publishing. The largest of the two is a mere shell; the bark alone remains, but it carries a fine head of recent growth, the original head having long since disappeared. When in its full glory it must have covered a sufficient space of ground for a military camp, as may be judged by these measurements:—At one foot from the ground its circumference is forty-four feet eight inches; at four feet from the ground thirty-one feet four inches. We did not measure it at the ground line, but it cannot be less than seventy feet there. The companion is the handsomest tree of the two, but is considerably smaller. Our way lies now along a hedgerow to the south-east corner of the common, where it is intersected by Copsam Lane. Under this hedgerow there is a grand display of British ferns, among them red-stemmed and red-leaved varieties of *Lastrea filix mas*, and plenty of lady-ferns. This Copsam Lane brings us to another part of Oakshott Heath, and by continuing the road we soon arrive at the school-house where we turned off to the left at starting, in order to reach the heath by that route.

It was a long and pleasant task to turn out all the specimens

beside a bright fire at the "Brown Bear." The papers were all dried, the vasculum stood open before the fire till all was done, and then the whole were packed again for transit home, and when taken out two days afterwards, they were all found to be in the best possible condition. The fungi were packed in moss in baskets, and with them the various tufts of roots reserved for cultivation.

My botanical peregrinations have this season been rendered



VASCULUM FOR PLANTS.

more enjoyable through the adoption of a new species of vasculum. It is a sort of expanding portfolio, containing five leaves of cardboard, bound at the edges with leather. The outer case is of stout board covered with Russia leather, with a flexible leather flap to close the front with lock and key. At the back there are straps and buckles to contract or expand as needful. At starting I fill the case with white blotting-paper, several thicknesses between the cards, and as soon as a speci-

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men is chosen it is laid between the blotting, and being fresh requires no laying out. Generally, the specimens when taken out are already nearly dried and well pressed, and only need a shift to fresh paper, and a few days' further pressure, to render them fit for mounting. For convenience of carriage a strap is passed round the case, and by this means it can be slung over the shoulder, or be carried in the fashion of a wallet. When closed the case measures seventeen inches by eleven inches, and when opened to its full extent it has a capacity of nine inches; when closed and empty it is exactly one inch thick. To make this description more intelligible, a diagram is subjoined.

A NEW TABLE-STAND FOR ASTRONOMICAL TELESCOPES.

BY THE REV. E. L. BERTHON, M.A.,

Vicar of Romsey, Hants.

THE want of a cheap and effective stand is much felt by the daily increasing numbers of amateur astronomers, and since the diminution in the prices of achromatic object-lenses has induced many to increase the size of their instruments, the following description of a stand recently invented and constructed will probably be well received.

The contrivance now made public is applicable for telescopes of any size up to eight feet or more, and possesses the advantages of great steadiness and ease in working, combined with lightness and considerable portability. It may be used on any very steady table, but a thick slab of very smooth *slate*, well supported on stone or brickwork, or if in a garden on three stumps of trees arranged in a rustic manner, is by far the best. These slabs are now very cheap, and are not injured by the weather.

The construction of the stand is simple and inexpensive, and secures great accuracy in operation without any particular nicety of workmanship. Its leading feature is that the tube, instead of resting on one joint, or *point d'appui*, has two distinct bearings. In fact it has two pairs of *trunnions*, one of which rests on the top of the main support, the other on the upper ends of two stiff rods, which are moved by a long screw, and perform the part of both steadying rods and elevators.

The tube is divided by the trunnions into three equal

parts, and simply reposes in its bearings without any stiff joints.

The following is a description of the accompanying perspective view.

Fig. 1 represents the new stand, with a 48-inch telescope

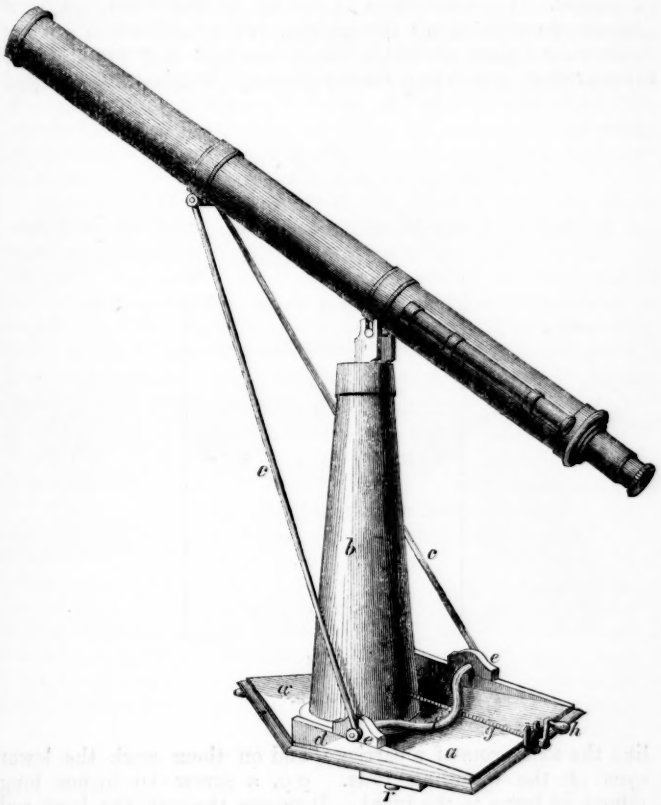

FIG. 1.

attached, and supposed to be placed on a slab of slate, say 3 feet long by 2 wide. *a a*, is a board of well seasoned mahogany, polished, 20 inches by 14. *b b*, a cone of galvanized iron, about 22 inches high, well secured to the board; fixed to the top of this cone are open bearings, to receive the after

trunnions of the tube. *c c*, a pair of steadying—or rather elevating-rods, half an inch thick, having eyes at their ends; those at the upper ends receive the foremost trunnions. *d d*, two inclined planes of mahogany secured to the board, rising $1\frac{1}{2}$ inch, and about 10 inches long; along the tops of these are rounded ridges of brass, accurately straight and smooth, to act as guides. *e e*, two little travellers of box-wood, grooved beneath to slide along the guides. *f f*, a bent rod of $\frac{5}{8}$ brass (hollow for lightness), which passes through and fits tight in the travellers, connecting them together; its extremities project

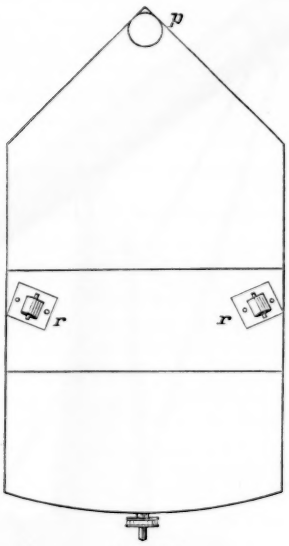

FIG. 2.

like the axle-arms of a carriage, and on them work the lower eyes of the elevating rods. *g g*, a screw 10 inches long (about 20 turns to the inch). It passes through the bent rod *f f*, working in a nut attached to its middle. *h*, a milled head on the screw, and a little winch or handle, which can be removed at pleasure. The screw turns in a bearing fixed to the stand at *h*.

This completes the mechanism for altitude. That for azimuth is very simple, and consists merely of two little well-turned rollers or wheels, *r r*, fixed to the stand beneath, and

so arranged that their axes radiate from the point p as a centre (see Fig. 2). At this point is a flat knob of brass or wood, about which the stand revolves. It may be put on any part of the table or slate slab, the weight being quite enough to keep it steady.

The mode of using this stand is as follows:—

The little winch handle being applied to the screw the tube is rapidly raised or lowered till the altitude of the star is attained, when it may be removed, and the finger and thumb applied to the milled head. Supposing the star to have been found, a gentle pressure towards the left, at the same time gently turning the screw up or down, will keep it in the centre of the field; and this is accomplished without fatigue or inconvenience, as the hand or hands rest on the slab.

This stand is found so steady in practice that the whole weight of the head, reposing on the eyepiece by resting the brow against a little pad, produces no motion or vibration. It has been suggested that some means should be employed to accelerate the motion when a great change of altitude is required. This might be accomplished, but the inventor ventures to think that as a telescope of the above dimensions can be raised from the horizontal plane to an altitude of 65° in one minute, it is rapid enough for most purposes. The inclined planes might have a greater gradient, if a still greater degree of elevation were required.

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RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

BY CHARLES CHAMBERS AND G. M. WHIPPLE.

1863.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2 P.M., and 5 P.M., respectively.		Rain—read at 9·30 A.M.
Day of Month.	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Calculated. Dew Point.	Calculated. Relative Humidity.	Calculated. Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	
	inches.	°	°		inch.	°	°	°			inches.
July 1	30·231	63·1	49·1	·62	·362	70·6	43·2	27·4	7, 2, 2	S by W, S, S by E.	·000
„ 2	29·985	60·2	51·8	·75	·397	69·3	54·5	14·8	8, 7, 9	SW by W, SW by W, SW.	·002
„ 3	30·169	61·9	48·6	·64	·356	69·5	52·5	17·0	3, 9, 4	NW, NW by W, W by N.	·000
„ 4	30·112	61·1	49·1	·67	·362	70·6	50·5	20·1	2, 7, 7	ENE, NW by W, NNE.	·000
„ 5	...	...	...	...	...	72·8	54·1	18·7	...	...	·000
„ 6	30·215	66·7	51·6	·61	·394	75·1	53·5	21·6	3, 0, 0	SE by E, SE, SE.	·000
„ 7	30·021	68·8	56·4	·66	·464	76·1	54·4	21·7	1, 2, 5	SW by W, SW, SW by W.	·000
„ 8	30·173	62·2	54·1	·76	·429	70·5	52·0	18·5	4, 9, 10	W, NW, WNW.	·000
„ 9	30·208	66·5	51·8	·61	·397	75·2	53·0	22·2	0, 4, 4	NW, ENE, ENE.	·000
„ 10	30·325	69·7	47·7	·48	·345	77·7	50·8	16·9	0, 0, 0	NNE, NE by N, NE by N.	·000
„ 11	30·339	67·5	51·5	·59	·393	76·1	51·9	24·2	10, 10, 8	NE by N, E by S, ESE.	·000
„ 12	...	...	...	...	...	77·8	52·2	25·6	...	...	·000
„ 13	30·423	61·3	50·0	·68	·373	68·7	58·9	9·8	10, 8, 10	NNE, NE, NE.	·000
„ 14	30·329	67·7	54·3	·64	·432	77·9	46·3	31·6	10, 10, 10	—, —, WSW.	·000
„ 15	30·152	70·4	53·2	·56	·416	80·5	49·5	31·0	5, 7, 10	W, —, N.	·000
„ 16	30·160	57·0	44·0	·64	·304	...	54·6	...	10, 10, 6	NE by E, NE, NE.	·000
„ 17	29·946	61·0	44·3	·57	·307	70·0	44·0	26·0	10, 5, 5	SW, SW by W, W by N.	·000
„ 18	29·789	54·5	38·1	·57	·247	62·9	45·0	17·9	10, 5, 3	NW by W, W by N, NNW.	·000
„ 19	...	...	...	...	...	67·6	39·5	28·1	...	...	·001
„ 20	29·756	57·6	41·8	·58	·281	64·8	48·5	16·3	4, 9, 10	NW, —, —.	·000
„ 21	29·724	55·4	55·3	·98	·447	62·9	45·3	17·6	10, 10, 10	S by E, SSE, SSE.	·010
„ 22	29·559	57·1	50·7	·81	·382	66·7	56·6	10·1	10, 10, 10	S by W, W by S, W by N.	·403
„ 23	29·861	58·5	45·5	·64	·320	66·7	48·4	18·3	6, 8, 7	W by N, WSW, W by S.	·160
„ 24	30·085	57·6	42·1	·59	·284	65·6	43·4	22·2	6, 10, 10	WSW, SW, W by N.	·000
„ 25	29·924	57·1	51·8	·84	·397	64·6	50·4	14·2	10, 10, 10	W, W by S, NW by N.	·000
„ 26	...	...	...	...	...	67·5	46·6	20·9	...	...	·181
„ 27	30·185	64·2	52·1	·67	·401	72·3	46·0	26·3	6, 6, 7	—, SW by W, S by W.	·000
„ 28	30·021	66·3	50·9	·60	·385	75·4	45·6	29.8	4, 6, 7	W, —, S by E.	·000
„ 29	29·991	65·7	50·8	·61	·384	75·1	50·2	24·9	3, 3, 6	NNW, W by S, NW by N.	·000
„ 30	30·186	60·3	42·3	·54	·286	69·4	52·6	16·8	1, 6, 4	NE, N, NE by N.	·000
„ 31	30·243	58·3	42·9	·59	·292	68·2	46·0	22·2	7, 4, 2	ENE, E by S, E by S.	·000
Monthly Means.	30·077	62·1	48·9	·65	·364	...	...	21·1	...	...	0·757

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER—JULY 1863.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
Hour.																																
12																																
A.M. 1	1	8	8	5	5	13	5	5	5	1	1	1	7	1	3	12	3	4	3	4	3	15	4	4	6	5	0	0	3	10	5	4·8
2	1	7	4	3	4	12	7	6	2	0	1	1	7	1	3	12	1	3	2	4	2	12	3	4	5	5	1	1	2	9	3	4·1
3	1	6	6	2	5	12	5	4	3	1	0	0	8	2	3	10	1	6	3	2	4	13	2	3	8	6	1	1	2	7	2	4·2
4	0	6	5	2	5	12	7	5	2	1	1	0	7	1	4	7	1	8	3	2	2	12	4	5	8	5	1	1	1	9	5	4·3
5	1	9	7	1	3	6	6	5	2	1	0	0	8	3	4	9	1	9	3	2	3	17	3	3	10	6	1	1	2	6	5	4·4
6	1	16	7	4	5	10	4	6	2	1	1	1	10	3	4	10	2	8	3	3	1	11	6	5	8	6	2	1	3	9	5	5·1
7	1	15	7	9	8	10	6	7	5	4	2	0	12	3	5	14	3	12	2	3	4	11	6	5	8	9	3	0	3	12	5	6·3
8	4	14	10	8	5	11	10	7	8	8	2	2	16	2	4	16	7	13	2	3	2	17	7	7	13	11	3	3	2	10	9	7·6
9	12	22	11	9	3	12	8	9	8	11	4	2	15	3	4	11	16	14	4	6	2	17	9	9	14	13	2	2	5	8	12	8·9
10	14	24	11	7	5	13	10	9	10	10	5	3	14	2	5	15	15	14	5	5	4	21	12	10	16	12	2	4	6	10	12	9·8
11	15	24	10	9	5	14	10	10	10	10	9	5	15	2	6	15	15	16	10	6	5	18	12	11	16	10	2	3	7	10	15	10·5
12	16	28	8	7	5	14	11	7	10	11	8	8	13	5	8	15	15	15	8	4	7	15	14	13	13	10	3	3	7	10	15	10·5
P.M. 1	15	26	6	5	3	16	11	9	10	14	6	10	12	2	7	17	12	12	12	4	6	22	10	11	9	8	4	5	8	10	17	10·3
2	15	26	7	4	6	19	12	7	9	11	9	9	10	4	4	13	10	11	12	4	7	21	14	11	6	9	3	5	9	8	18	10·1
3	17	26	7	4	5	17	10	9	7	11	8	8	10	4	6	10	13	10	13	4	8	19	13	13	10	6	4	6	8	9	18	10·1
4	16	22	5	5	5	10	13	7	8	13	10	9	11	5	8	7	12	16	12	4	9	20	14	10	7	7	4	4	7	9	17	9·9
5	15	22	8	4	7	19	14	7	12	11	8	9	12	4	6	9	13	15	13	2	9	17	13	10	9	5	3	5	10	14	20	10·5
6	13	18	7	4	9	13	10	5	9	11	6	8	11	5	4	9	9	12	12	3	10	18	12	7	5	6	12	2	13	9	17	9·3
7	9	15	5	6	7	16	8	4	11	10	6	8	11	3	2	9	6	10	9	1	10	19	8	5	3	4	10	6	7	11	17	8·3
8	6	12	4	6	8	15	12	1	8	10	6	6	9	1	1	11	7	8	8	3	17	15	7	6	2	2	10	5	5	8	14	7·5
9	8	8	1	5	24	18	8	2	5	7	4	5	6	1	3	5	7	1	10	4	14	8	5	8	8	3	4	5	2	9	15	6·9
10	7	11	3	6	15	15	9	1	2	5	1	6	2	6	7	5	7	4	12	4	19	4	5	7	3	1	1	3	10	5	17	6·5
11	7	9	5	6	14	16	9	3	2	3	2	2	2	3	8	3	4	4	9	5	13	5	5	9	4	1	1	5	12	4	16	6·2
12	5	7	5	5	12	5	6	4	1	2	1	7	1	2	8	1	4	2	4	3	17	7	4	8	6	0	1	5	10	4	9	5·0
Total Daily Movement.	200	381	157	126	173	318	211	139	151	167	101	110	229	68	117	245	184	227	174	85	178	354	192	184	197	150	78	76	144	210	288	7·5

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1863. Day of Month.	Reduced to mean of day. Barometer, corrected to Temp. 32°.*	Temperature of Air.	Calculated. Dew Point.	Relative Humidity.	Tension of Vapour.	Temperature of Air. Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	At 9·30 A.M., 2 P.M., and 5 P.M., respectively. Proportion of Sky clouded,	Direction of Wind.	Rain—read at 9·30 A.M.
	inches.	°	°		inch.	°	°	°			inches.
Aug. 1	30·059	62·4	47·0	·59	·337	71·8	49·9	21·9	3, 5, 10	E by N, E by N, E.	·000
„ 2	...	...	...	...	...	76·9	55·0	21·9	...	...	·000
„ 3	29·997	65·3	55·3	·72	·447	72·4	55·4	17·0	9, 9, 9	SW by S, SSW, SW.	·000
„ 4	29·875	62·9	56·8	·82	·470	71·7	53·7	18·0	8, 8, 9	SW by S, SSW, SW.	·007
„ 5	29·865	62·1	49·9	·67	·372	71·4	55·6	15·8	10, 10, 8	W, W by S, W.	·157
„ 6	29·917	61·4	52·0	·73	·400	68·9	57·9	11·0	10, 9, 10	SW, SW, WSW.	·137
„ 7	30·047	68·6	61·6	·80	·551	75·7	61·1	14·6	10, 9, 7	SW, SW, SW.	·013
„ 8	30·079	68·2	61·2	·80	·544	76·1	62·4	13·7	8, 9, 4	SW by W, SW, SW by W.	·003
„ 9	...	...	...	...	...	80·9	57·4	23·5	...	...	·002
„ 10	30·058	67·8	57·5	·71	·481	77·9	59·7	18·2	9, 5, 6	NW, SW by W, WSW.	·000
„ 11	29·993	64·5	49·5	·60	·367	74·3	57·9	16·4	10, 4, 3	W by S, W, W.	·000
„ 12	30·031	62·8	46·7	·58	·333	71·0	50·6	20·4	4, 6, 9	N by E, NW by N, N.	·000
„ 13	29·906	66·0	52·7	·64	·409	75·2	52·4	22·8	9, 8, 10	E by S, ENE, ENE.	·000
„ 14	29·982	63·9	53·2	·70	·416	72·6	56·3	16·3	7, 7, 10	E by N, E by N, E by N.	.000
„ 15	29·802	68·8	56·3	·66	·462	77·5	52·4	25·1	8, 4, 1	SW by W, S by W, SW by S.	·000
„ 16	...	...	...	...	...	74·7	58·5	16·2	...	...	·017
„ 17	29·694	57·9	47·8	·71	·346	68·9	55·1	13·8	5, 7, 10	W by S, WSW, WSW.	·000
„ 18	29·819	55·0	46·2	·74	·328	62·8	48·5	14·3	9, 10, 9	WSW, W, W by N.	·061
„ 19	29·797	53·0	53·5	1·00	·420	62·6	51·8	10·8	10, 10, 7	SSW, SW, W by S.	·080
„ 20	29·994	54·2	42·5	·67	·288	60·8	50·6	10·2	8, 10, 7	NW by W, NNW, WNW.	·137
„ 21	30·130	57·4	43·9	·63	·303	64·0	45·0	9·1	8, 10, 10	N by W, NWbyW, NWbyW.	·003
„ 22	30·046	59·1	52·4	·80	·405	68·4	51·9	16·5	10, 10, 10	W, —, WSW.	·007
„ 23	...	...	...	...	...	71·8	55·7	16·1	...	...	·028
„ 24	29·852	61·6	48·0	·63	·349	68·1	58·0	10·1	8, 9, 1	WSW, SW, S by W.	·000
„ 25	29·551	57·8	50·9	·79	·385	69·0	50·3	18·7	6, 9, 8	S by E, SW by S, SSE.	·010
„ 26	29·467	54·4	53·1	·96	·415	63·0	50·4	12·6	10, 10, 10	SW by S, SSE, ENE.	·426
„ 27	29·408	59·7	53·8	·82	·425	67·5	55·2	12·3	9, 10, 10	S by E, S by E, S.	·525
„ 28	29·639	61·6	52·4	·73	·405	71·9	49·5	22·4	7, 6, 6	S, S by W, S by W.	·022
„ 29	29·753	58·6	51·9	·80	·398	67·8	52·5	15·3	6, 8, 6	SW by S, W by N, NW by W.	.107
„ 30	...	...	...	...	...	68·9	49·4	19·5	...	...	·013
„ 31	29·810	56·5	51·2	·83	·389	64·6	55·6	9·0	10, 9, 10	S by E, W, WNW.	...
Monthly Means.	29·868	61·2	51·8	·74	·402	...	...	16·2	...	... ...	1·755

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—AUGUST 1863.

Day.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
Hour.																																	
12																																	
1	A.M.	9		2	7	6	11	16	11	8	6	9	6	5	10	3	12	11	8	8		6	2	5	12	3	11	11	1	3	1		7·3
2	A.M.	8	385	4	7	5	11	12	14	8	6	12	5	7	9	3	11	10	7	8	219	6	2	5	12	5	12	6	6	3	3		7·4
3	A.M.	10		5	4	4	12	14	11	8	6	11	6	8	10	3	9	8	8	6		4	3	5	15	5	13	3	5	5	2		7·3
4	A.M.	9		5	6	5	11	10	11	9	8	8	3	8	10	5	6	8	8	7		3	2	4	13	3	13	6	2	4	2	327	6·8
5	A.M.	7		4	12	4	14	15	10	7	9	10	3	5	11	5	11	10	7	6		3	4	9	13	5	9	10	2	5	2		7·6
6	A.M.	8		4	11	4	16	15	12	8	8	11	3	5	14	3	11	8	6	8		3	3	8	10	4	8	9	2	8	2		7·6
7	A.M.	14		9	11	4	18	13	12	8	10	12	5	5	20	9	14	12	5	10		6	4	8	14	5	9	13	3	10	3		9·5
8	A.M.	14		14	21	5	19	14	15	9	10	13	5	10	25	13	19	8	10	10		5	6	11	15	10	9	15	5	10	4		11·6
9	A.M.	13		14	22	3	19	13	18	11	9	12	6	9	29	19	20	12	14	8		8	7	8	11	17	8	15	9	14	7		12·7
10	A.M.	13		17	23	4	20	15	15	12	9	15	8	9	25	21	17	13	15	11		7	6	15	14	12	7	23	13	17	8		13·7
11	A.M.		8	15	23	4	18	14	19	11	7	14	8	9	27	26	17	14	15	10	17	7	6	20	14	17	10	21	12	16		34	14·9
12	A.M.		10	20	22	5	21	13	17	10	16	14	6	10	24	22	21	19	15	8	17	9	6	23	13	26	12	26	10	17		28	15·7
1	P.M.		8	25	25	8	23	14	19	8	11	11	7	12	23	28	25	20	15	9	16	8	6	20	14	25	14		13	18		24	16·0
2	P.M.		14	21	25	10	20	16	17	9	14	10	7	13	21	26	24	17	16	15	21	8	3	22	15	23	12		10	16		26	16·1
3	P.M.		14	19	20	10	18	17	19	8	14	10	4	11	24	29	26	21	14	9	16	11	3	22	16	27	11	115	13	13		15	15·5
4	P.M.		14	15	21	9	20	20	19	11	16	10	5	15	21	27	23	14	15	9	15	8	4	24	17	28	11		14	10		10	15·2
5	P.M.		17	18	10	14	15	15	16	13	15	9	6	20	18	24	25	11	16		17	8	7	24	17	8	9		13	10		11	14·3
6	P.M.		15	19	12	12	15	13	17	11	14	9	5	20	18	26	23	10	16		13	6	9	18	19	10	10	12	7	5		9	13·3
7	P.M.		14	17	16	11	20	16	14	12	14	5	6	21	13	23	22	7	14		10	9	4	19	17	10	20	13	4	5		11	13·1
8	P.M.		6	12	17	14	15	14	13	7	10	6	13	20	6	12	16	7	10		6	2	5	15	13	6	12	10	1	1		14	10·1
9	P.M.		9	8	5	10	15	13	8	8	8	5	13	14	2	13	13	8	10		8	4	6	11	10	14	11	4	0	2		9	8·6
10	P.M.		6	11	5	10	15	10	8	8	6	7	13	13	4	11	11	7	10		8	2	5	12	9	9	9	7	1	5		9	8·2
11	P.M.		5	9	4	14	15	15	9	6	9	6	12	14	3	9	10	8	9		8	3	6	13	6	12	16	8	9	5		7	8·9
12	P.M.		4	7	5	11	18	13	8	3	7	6	9	9	3	7	10	7	8		6	2	5	13	5	9	12	5	5	3		8	7·4
Total Daily Movement.			634		294	334	186	399	340	332	213	236	235	164	272	370	367	396	270	271	539		138	114	334	314	293	268	332	160	205	576	11·5

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1863. Day of Month.	Reduced to mean of day. Barometer, corrected to Temp. 32°*	Temperature of Air.	Calculated. Dew Point.	Relative Humidity.	Tension of Vapour.	Temperature of Air. Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9.30 A.M.	Daily Range.	At 9·30 A.M., 2 P.M., and 5 P.M. respectively. Proportion of Sky clouded.	Direction of Wind.	Rain—read at 9·30 A.M.
	inches.	°	°		inch.	°	°	°			inches.
Sept. 1	30·045	55·5	43·2	·66	·295	63·1	44·0	19·1	6, 4, 4	WNW, SW, W by N.	·063
„ 2	29·792	53·3	52·1	·96	·401	63·6	52·4	11·2	10, 10, 10	S by W, SW by S, S by W.	·012
„ 3	29·748	57·9	51·5	·80	·393	66·1	54·2	11·9	8, 8, 9	S, S by W, SW.	·196
„ 4	29·856	57·5	49·0	·75	·361	63·9	50·3	13·6	7, 9, 6	WSW, S by E, SW by S.	·326
„ 5	29·709	54·7	52·1	·92	·401	61·8	46·1	15·7	10, 10, 10	WSW, S by W, SW.	·062
„ 6	...	...	...	...	...	62·4	47·1	15·3	...	...	·280
„ 7	29·698	56·7	41·7	·60	·280	62·7	51·9	10·8	3, 4, 7	SW by W, W by S, WSW.	·360
„ 8	29·959	54·1	47·9	·81	·347	60·7	46·6	14·1	5, 10, 10	WSW, SSW, SW.	·003
„ 9	29·747	55·8	53·0	·91	·413	62·9	51·0	11·9	9, 9, 9	S, —, N by E.	·072
„ 10	29·941	49·8	42·9	·79	·292	60·2	48·5	11·7	0, 10, 7	NW by W, N, W.	·304
„ 11	30·198	53·2	41·6	·67	·279	60·0	43·5	16·5	4, 6, 2	NW, W by N, NW by W.	·000
„ 12	30·216	54·7	44·7	·71	·311	61·1	43·9	17·2	3, 9, 10	SW, SW, SW.	·000
„ 13	...	...	...	...	..	64·1	49·0	15·1	...	...	·000
„ 14	30·331	52·4	45·8	·80	·323	59·3	43·8	15·5	10, 10, 10	W by S, W by N, NW by W.	·000
„ 15	30·136	52·1	44·9	·78	·313	58·5	51·5	7·0	10, 10, 10	W, WSW, SW by W.	·000
„ 16	30·041	53·9	41·9	·66	·282	60·1	51·5	8·6	4, 7, 8	W, W, W by N.	·000
„ 17	30·106	55·5	45·1	·70	·315	62·5	42·8	19·7	7, 4, 1	W, WSW, WSW.	·000
„ 18	30·068	56·9	47·6	·73	·344	63·7	47·0	16·7	10, 4, 0	SW, SW by S, SW.	·000
„ 19	29·737	57·8	53·4	·86	·419	68·3	49·0	19·3	3, 9, 10	SW, SW, SW.	·000
„ 20	...	...	...	...	...	58·2	50·1	8·1	...	...	·597
„ 21	29·117	49·5	41·3	·75	·276	57·6	...	...	8, 9, 4	WSW, W, WNW.	·010
„ 22	28·930	49·9	40·8	·73	·272	57·7	45·9	11·8	10, 6, 7	WSW, WSW, SW by W.	·008
„ 23	29·148	49·5	42·1	·77	·284	58·1	41·2	16·9	4, 7, 6	WSW, SW, SW.	·005
„ 24	29·383	47·3	44·9	·92	·313	56·5	38·0	18·5	10, 8, 9	S, S by W, S.	·059
„ 25	29·722	52·8	44·4	·75	·308	60·2	41·1	19·1	2, 5, 3	SW, SW, SW.	·178
„ 26	30·074	49·4	43·0	·80	·293	57·8	35·3	22·5	8, 7, 7	W, W by S, W.	·009
„ 27	...	...	...	...	...	57·9	36·5	21·4	...	...	·014
„ 28	29·834	49·4	40·5	·74	·269	56·7	37·3	19·4	10, 4, 1	W by S, W by S, W by S.	·204
„ 29	30·011	50·4	41·3	·73	·276	58·1	36·0	22·1	2, 4, 3	SW, SW by S, SW.	·056
„ 30	29·728	52·4	47·0	·83	·337	60·8	30·1	30·7	9, 10, 10	NE, SSE, ESE.	·000
Monthly Means.	29·818	53·2	45·5	·77	·323	...	...	15·9	...	... ...	2·818

*To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—SEPTEMBER 1863.

Day.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hourly Means.
Hour.																																
A. M.	12	7	9	10	3	5	10	23	11	6	9	5	3	6	4	4	8	6	3	1	14	11	13	7	3	6	4	5	19	3	1	7·3
	1	5	12	12	4	5	10	27	7	5	7	4	4	7	4	3	8	5	5	1	12	11	13	6	1	7	2	5	18	4	1	7·2
	2	5	11	10	3	5	11	26	6	6	7	4	5	6	3	4	6	3	6	4	12	12	12	7	2	6	4	5	19	3	1	7·1
	3	5	11	8	3	4	11	24	8	5	6	3	4	4	4	5	6	5	3	3	12	9	13	8	2	2	4	2	20	5	1	6·7
	4	4	10	6	5	4	10	22	7	6	7	7	4	6	4	5	5	3	4	6	11	10	13	9	3	4	2	4	18	4	2	6·8
	5	5	10	5	4	6	9	18	9	4	8	2	6	6	4	5	7	5	7	5	13	9	10	8	1	3	2	4	22	1	2	6·7
	6	4	10	10	3	7	11	13	8	5	4	3	3	6	5	6	8	5	5	3	13	9	11	9	5	4	2	5	25	2	1	6·8
	7	7	14	16	5	12	13	17	10	7	8	5	6	7	3	8	7	7	7	2	13	12	11	12	9	4	4	12	24	2	3	8·9
	8	10	14	15	9	13	17	20	13	9	10	10	6	11	6	8	10	8	7	5	11	14	12	14	9	6	5	16	24	5	2	10·6
	9	10	15	17	14	17	17	20	13	10	14	12	10	14	6	12	13	8	11	10	8	15	12	18	10	12	6	20	13	9	2	12·3
	10	12	17	17	13	17	17	24	16	5	14	11	13	11	5	13	13	11	11	22	13	14	13	16	12	13	10	16	10	13	6	13·3
	11	12	15	18	10	20	17	23	15	5	11	10	13	13	6	13	14	12	11	24	10	14	14	14	10	13	12	19	11	15	10	13·5
	12	13	22	16	16	21	16	23	16	7	13	9	12	13	8	11	13	12	7	27	14	16	18	14	9	15	12	22	16	11	13	14·5
P. M.	1	12	19	16	19	15	18	21	18	5	15	10	12	11	8	13	11	12	6	26	16	18	14	11	8	11	11	24	18	11	10	14·0
	2	13	19	15	18	15	15	23	17	3	11	6	11	13	7	13	12	10	4	23	17	14	15	16	8	13	12	24	17	9	12	13·5
	3	11	21	18	16	19	15	22	15	2	9	6	9	11	7	13	11	11	8	24	19	11	17	9	12	10	9	22	17	9	11	13·1
	4	9	16	9	19	19	15	18	17	5	6	5	7	10	5	10	7	10	8	28	15	11	11	9	9	8	7	22	13	9	13	11·7
	5	5	15	7	13	17	14	19	16	2	5	4	7	9	6	9	7	8	6	29	11	9	11	7	10	6	3	23	7	8	16	10·3
	6	8	13	6	11	13	13	16	14	1	5	3	4	8	3	8	6	6	4	28	9	11	15	6	10	4	2	20	8	6	16	9·2
	7	11	13	6	8	16	14	13	15	1	4	4	6	5	4	9	5	6	5	28	10	8	15	7	11	4	3	20	7	3	18	9·3
	8	8	9	6	7	15	16	14	13	1	4	4	5	11	4	8	5	6	5	28	9	8	13	5	8	5	3	18	6	2	25	9·0
	9	8	9	3	5	9	16	15	12	3	3	5	5	4	3	9	6	3	4	29	9	11	9	6	3	3	3	21	6	1	21	8·1
	10	10	9	2	3	11	19	11	11	7	6	5	5	3	3	7	7	4	3	28	11	13	6	5	3	3	4	25	6	0	20	8·3
	11	9	6	1	4	11	22	10	10	5	4	4	5	3	4	6	6	4	2	23	11	13	7	3	4	4	3	19	3	1	23	7·7
	12																															
Total Daily Movement.		203	319	249	215	296	346	462	297	115	190	141	165	198	116	202	201	170	142	407	293	283	298	226	162	166	129	373	347	136	230	9·8

A NEW KIND OF MINIATURE.

A VERY ingenious and beautiful application of optical principles to the mounting of photographic miniatures has been recently made by Mr. Henry Swan, of the "Casket Portrait Company," Charing Cross. The effect of the new process is to exhibit the subject of the portraiture with life-like verisimilitude, and in natural relief. You take up a small case, and look through what appears to be a little window, and there stands or sits before you, in a pleasantly-lighted chamber, a marvellous effigy of a lady or gentleman, as the case may be. The projection of the nose, the moulding of the lips, and all the gradations of contour, are as distinct as if an able sculptor had exercised his skill; but the hair and the flesh are of their proper tint, and the whole thing has a singularly vital and comfortable look. Indeed, were it not for the reduction in size, it would be difficult to avoid the belief that an actual man or woman, in ordinary dress, and with characteristic expression, was presented to your eye. We might, indeed, compare these admirable pictures to accurate reflections of the persons themselves in a diminishing glass, and no one can see them without being struck with their marked superiority over ordinary portraits.

In order to produce these beautiful and unexpected effects, two portraits, taken at a suitable angle, are arranged upon two prisms, placed almost in contact so as to form a quadrangular block. Each prism is ground to an angle of 39° or 40°; one picture is placed at the back of the combination and another at the side of the prism nearest the eye. When we try to look through the combination, the two images are combined in one stereoscopic picture, and the action is thus explained in a paper read by Mr. Swan before the British Association, at their Newcastle meeting, where the portraits were much admired:—"The reason of this curious phenomenon is, that all the rays which fall on one side of a line perpendicular to the surface of the prism next the eye suffer total reflection at the oblique inner surface of that prism, while the rays which fall on the other side are transmitted unaltered through the body of the combination. Thus it is that one of the eyes only perceives the object at the back of the prisms, while to the other the picture at the side is alone visible, that, apparently, being at the back also. It necessarily follows that if the pictures have been taken in accordance with the principles of binocular vision, the resulting image seen in the interior of the crystal will be quite solid, every detail being wrought in perfect relief with the most exquisite delicacy. To the scientific observer it will be evident that, to produce the effect intended, care must be taken not

only that the picture shall not be misplaced, so as to produce the pseudo-scopic effect, but also that the image which suffers reflection shall be reverted, to compensate for the reversion which takes place when reflexion occurs.

In addition to portraits destined for morocco cases, and of ordinary minature sizes, much smaller ones are taken and mounted in exceedingly pretty little caskets of fine gold. These form as elegant little shrines as any lover could wish to receive the effigy of his mistress, and far surpass any other mode yet devised of connecting portraiture with ornamental jewellery. The stereoscopic effect is quite as perfect as in the larger patterns, and the photographs are so judiciously coloured that their fidelity to nature is in nowise impaired.

All the casket portraits are viewed as transparencies, the photographs being printed from ordinary negatives on small mica plates which are affixed to the prisms.

We have appended Mr. Swan's *rationale* of his process without comment, and our optical readers can investigate this curious question for themselves. There is not the slightest doubt of the magical relief of the portraits, but we are not quite sure that the effect is entirely dependent upon the causes which Mr. Swan particularises. We recommend all who have an opportunity of going to Charing Cross, to see these portraits for themselves. Few will be contented to leave the studio without making arrangements to possess some specimens of the artist's skill, and all must admit that they have never before seen the stereoscopic principle so beautifully carried out. Mr. Swan's is one of those happy inventions in which art and science join, and his labours will be appreciated to the extent that they are known.

XUM

THE EARTHQUAKE OF OCTOBER, 1863.

ALTHOUGH earthquakes in Great Britain are by no means rare occurrences, that which occurred on the 6th of October was remarkable for an amount of violence seldom experienced in these usually quiet isles, and those who did not themselves feel the late concussion were scarcely less startled by the alarming accounts with which the newspapers were filled on the following day.

Our present purpose is to endeavour to place on record the most important facts that were observed, and to supply a little earthquake philosophy, by the light of which the incidents may appear in a more interesting light. Thanks to telegrams, newspaper correspondents, and the penny post, the materials are not scanty, although few can be affirmed to be exact. In its extent the shaking was reported from a point about twenty miles off Pembroke, in the west, to some place of which the name is not given, on the Yorkshire coast, to the east. If, however, it was really felt at the latter place,* it must have been very feeble, and we are not aware of any authentic record of noticeable disturbance more east than Gad's Hill, near Rochester, where it gave Mr. Charles Dickens the sensation of a great beast uplifting itself under his bed. At Ashford, in Kent, we are assured it was not felt, and thus its eastern range was probably very small.

In the absence of accurate standards of measurement, we are driven to secondary evidence in our attempt to say where the greatest violence was exerted; but no place appears to have been more strongly affected than Hereford and its vicinity, while the concussion may have been equally severe in the Black Country of Staffordshire, and on Sedgely Beacon, N.N.W. of Dudley, in the same county. It was likewise severe at Lyerney, in Gloucestershire, and was called violent at Taunton and Wellington, in Somerset.

The time at which the principal shock was felt can scarcely have been the same in different localities, even making allowance for the probable difference of clocks. Everton, near Liverpool, claims to have felt premonitory rumblings at 11 P.M. of the night of the 5th; Clifford, in Herefordshire, was stated to have been affected at 2·30, and Taunton is stated to have received a violent quaking at 2·40.

Of these early times we may regard that of Everton as doubtful, and that of Clifford, from which we have received more accurate information, as a decided mistake. The latest shock is stated to have been felt at Swansea and Nailsworth, which

* We are informed it was *not* felt at Scarborough.

enjoyed a parting rumble about 4 P.M., after having had their share in the earlier distribution. Sorting out, from the various communications to the daily press, a few of the most important places in the line of attack, we may make two lists, the first comprising those in which the shaking is alleged to have been experienced about 3 A.M. on the morning of the 6th, and the second including others chiefly affected at or near 3·30 A.M. of the same day. The first list, it will be seen, is rich in western names. It is as follows :—

Twenty miles off Pembroke	about	3
Newport, S. Wales, first shock	.	3·10
Merthyr Tydvil	about	3
Neath	,,	3
Cardiff	,,	3
Upwey, Dorset	,,	3
Gloucester	,,	3
Portsmouth	,,	3
Stone, Staffordshire	,,	3

The half-past three time-list comprises localities far apart—

Axminster	3·30
Barnstaple	3·30
Monmouth	3·30
Beeston Observatory (Notts)	3·30
London	3·30
Dorrington, near Shrewsbury	3·30
Hereford and vicinity	3·23

The force of the earthquake was very trifling compared with the gigantic concussions of which other countries are frequently the seat, and we possess very slender means of measuring its intensity by actual reference to work performed. Mr. E. J. Lowe informs us that many persons in the neighbourhood of Beeston Observatory, near Nottingham, were awoke by the shaking of their beds and windows, and to this general testimony he adds the more precise intelligence that the motion of his earthquake-pendulum was from W.N.W. to E.S.E., and "the displacement of chalk by the thirty-feet rod was half an inch, the index-needle moving the chalk so as to leave an oval or rather lengthened-oval hole." He considers there must have been at least two shocks —one at 2·35 and another at 3·30 A.M. During the latter, "the zero pencils on his atmospheric recorder marked the paper in a remarkable manner."

No large object is reported to have been displaced anywhere; but it is not unlikely that careful inquiries would lead to the discovery of fissures in old and weak buildings or walls; though we should think the concussion could not have had force to damage any that were sound. At Barnstaple, Liverpool, Sedgely, and some other localities, small articles are affirmed

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to have been thrown down, and a clock was stopped at the Royal Hotel, Waterloo. The noise from the shaking of doors and furniture caused many persons, in various districts, to fancy that burglars were violently breaking into their premises, and notwithstanding the doubts that certain incredulous persons have thrown upon the statements that alarming sounds were heard, besides the rattling of domestic apparatus, we are satisfied that some at least of these stories are true.

Noises of undoubted loudness often pass by with little notice if attention is otherwise directed. Their effect upon the ear will also depend greatly on the nervous condition of those who hear them. Thus, a few weeks before the earthquake, a loud peal of thunder rolled over London between nine and ten one evening. It caused great alarm to the spectators at one of the theatres, who may have been worked up by a sensation story; and in one house we know it induced the cook to rush into the scullery, expecting to witness a tragic catastrophe amongst her plates and pots, while in an adjacent house the sound was scarcely heeded by any member of the family.

We must, in the face of such facts, which every one's experience can easily multiply, not place too much stress upon negative evidence, and fancy that no noise existed because some persons did not attend to it. Fortunately, we are able to give some reliable information on this point, and shall first cite a very interesting letter with which we have been favoured by the Rev. Henry Cooper Key, whose scientific attainments give great value to his testimony.

Stretton Rectory (Mr. Key's abode) is about three miles west of Hereford, and he tells us that "the impression of all those in this neighbourhood qualified to judge is that the shock was more severe here than elsewhere. The magnitude of the sound is undoubted. My house is a new one, and very strongly built, and I certainly did not confound the noise caused by the shaking of articles in the house with that of the earthquake. I distinctly heard the noise approaching for some seconds, until the house was violently jarred, as if a train had run against it, and then the solemn sound died away in the distance: it was *much deeper* than thunder, and almost my first words were, 'Surely no one could have slept through such a noise as that.' The jar that went through my frame was horrible, and such as I shall never forget. I am so sound a sleeper that mere thunder hardly ever wakes me."

Mr. Key considers the shock was propagated in a straight line nearly N.E. and S.W., but also "diverging in two directions, say from Macclesfield towards Pembroke, and also from Sheffield towards London."

Our valued astronomical contributor, the Rev. T. W. Webb,

who resides at Hardwick Parsonage, about fifteen miles due west of Hereford, did not leave his telescope on the night of the quake until half-past two. He was awakened by "a wonderful clattering of doors and windows," then went to sleep again. Mr. Webb found little certainty in many of the accounts given concerning the direction of the shock, but the balance of evidence was in favour of its arrival from W.S.W. He remarks, "There is the strongest discrepancy between the accounts of people living in almost contiguous houses, partly from temperament, I suppose, and I suspect partly from the diagonal or perpendicular presentation of the walls." This last observation is highly important; and presuming the concussion wave to have travelled in any given line, say, from W.S.W., towards the opposite point of the compass, the effects of the shock upon buildings of somewhat similar height and strength would be found to vary with the direction of their walls.

An intelligent farmer's wife gave Mr. Webb the following interesting particulars:—Her husband, being awake, heard the sound coming, as of thunder, only not quite like thunder, somewhat lighter, then the whole house trembled altogether, then a door between their room and the next was so slammed to and fro, she thought her sick child on the other side was attempting to open it. Her husband went to open it, and found all safe, and then, but not before, came one great push at the bed.

In the neighbourhood of Clay Cross, near Chesterfield, the shock was scarcely noticed, and in a letter from Charles Binns, Esq., of that place, we are informed that although many men were working at night in the pits and about the works, none mentioned any unusual sound or motion. Mr. Binns considers that it did not extend so far north of the Backbone Ridge as Clay Cross and Chesterfield.

Some observers, in what appears to have been the line of principal disturbance, thought the shock came from the eastward, and others from the west, but it is very easy to be mistaken in this matter. Where the local earth-structure presents curved beds of emergent hard rocks lying between bad conducting bodies, such as soft clays or loose sand, the concussion wave would be materially deflected; but, notwithstanding minor peculiarities, the general direction was probably from some point west of south to another point east of north. The *Earthquake Catalogue* of the British Association, published in 1858, states the mean horizontal direction of British earthquakes to be "from south to north, veering more or less to the east or west, but having on the whole a direction passing through the probable focus of the Lisbon earthquakes, and of the Canary Islands." The same work informs us that 234 earthquakes are

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recorded as having occurred in the British Isles and Northern Isles, from the 11th century to the 19th, of which 56 took place in winter, 42 in spring, 52 in summer, and 67 in autumn.

Superstition has, in all ages, made use of earthquakes by exaggerating their horror, misstating their character, and ascribing them to causes of an unnatural kind. Science, however, shows that they are phenomena continually occurring: not a day passes in which many do not shake certain portions of the earth, and though we are only beginning to understand the laws that regulate their action, enough has been ascertained to warrant the positive assertion that they are subservient to purposes of order, and, strange as it may seem, belong to the *conservative* forces operating upon our globe.

The question, "What is an earthquake?" will occur to all inquiring minds, and can only be approximately answered. Formerly it was fancied that the earth was a sort of bottle filled with a huge mass of molten matter, in an incandescent state, and then earthquakes and volcanic eruptions were easily accounted for by supposing that the fiery fluid in its expansions burst more or less completely through the crust of our globe. This theory was partly founded upon the hasty induction that because, within small limits, descending into the earth conducted us to a warmer region, it must continue to do so within any limits, and that we should soon come to a zone in which all known substances would be melted with fervent heat; and partly upon an equally unwarrantable corollary from the nebular hypothesis. According to this supposition, all the globes that people space were once *gaseous*, and gradually condensed as they cooled, till, at a certain stage of the process, they were composed of incandescent fluids, surrounded by a thin crust of matter that had parted with sufficient heat to assume the solid form. Those remarkable bodies, the *nebulæ*, of which Mr. Webb discourses so admirably, were imagined to be worlds in this incipient or gaseous stage, and when the telescope resolved some of them into hosts of remote and widely-separated stars, bad reasoners in science said the nebular theory was overturned, although it was not at all affected by the splendid discovery that had thus been made. *How* our earth passed from earlier stages to its present form we do not know, nor can we tell what those stages were. If, however, the nebular theory had been proved, it would not have necessarily followed that our earth had made such slight advances towards solidification as to be a mere shell with fluid contents. More complete research shows that we know only an infinitesimal portion of the earth's past history, and that its present condition is that of a very strong and solid globe. Mr. Hopkins long ago showed, by mathematical investigation, that the earth-crust could not be less than eight

hundred miles thick, and Professor Wm. Thompson, making independent calculations from another class of well-ascertained facts, concludes that it must be as thick as half its radius, and thus the notion of its being a bottle full of fiery fluid is definitively dispelled.

What, then, is an earthquake? It would seem to be a concussion given to a portion of the earth at a certain depth below the surface by forces of an igneous kind. A sudden heating and expansion, a sudden irruption into a place where there was no room for it, of a fluid or gaseous matter, would, so to speak, give a thump in *all* directions to surrounding substances. The particles struck would hand on the blow, just as one billiard-ball transmits it to another, and some of the waves of this concussion would make their way towards the surface, and emerge at a certain angle, capable of being observed.

Until a very recent period no one thought of applying the principles of mechanics to the elucidation of the phenomena of earthquakes, and to Mr. Mallet belongs the chief credit of the great advance that has been made in the methods of observing and interpreting the effects they produce. His great work on *Observational Seismology** is the authority to which all students must refer, and as it is comparatively little known outside a limited circle of scientific men, we propose to resume the subjects of earthquakes in our next number, and to do our best to present a difficult and very technical subject in a popular form. To many minds the name Seismology will be as alarming as an earthquake itself. The meaning of the word will, however, be at once apparent to the Greek scholar, as it is derived from *seismos*, a concussion, and *logos*, a discourse; and if we followed the good fashion of the Germans in inventing vernacular names, we might convert all the "ologies" into "talk-abouts," or "lores," and Seismology would be "shock talk-about," or "shock-lore"—a dissertation on concussions and their effects.

Mr. Mallet's work *ought* to be found in the library of every scientific institution, and in all other public libraries that make any pretence to further intellectual pursuits. It belongs to a class of richly illustrated books of high practical value, which are necessarily too expensive for most private students to purchase in any quantity, but which must be made accessible, if the higher branches of education are to progress.

* *The First Principles of Observational Seismology*, as Developed in the Report to the Royal Society of London, of the Expedition made by command of the Society into the interior of the Kingdom of Naples, to investigate the circumstances of the great Earthquake of December, 1857, by Robert Mallet, C.E., F.R.S., F.G.S, M.R.I.A., etc., etc. Published by the authority and with the aid of the Royal Society of London. 2 vols. 8vo. *Chapman and Hall.*

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It is highly important to bring earthquake phenomena within the domain of exact science, because it is evident that they arise from agencies that play an important part in preserving the *stability* of our globe, which does not result from *quiescence*; a condition unknown to nature, but from the balance of forces operating in various directions. No portion of the earth is *still;* all is subject to actions of degradation and reparation, levelling and elevation, and were earthquakes and their causes to disappear, the result would be eminently destructive to the system as a whole. These facts will appear more plainly when we proceed to expound the elements of the new science of Seismology, and although a great deal remains to be done before that science can reach its maturity, it is already entitled to no inconsiderable rank among the various branches of physical investigation. Not only must we consider earthquakes and volcanic eruptions with which they are associated as belonging to the regular and methodical sequence of terrestrial changes, but we have already some inklings of their being in some way connected with the system of which we form a part. In fact, all phenomena of light, heat, electricity, magnetism, and mechanical impulse are correlated to each other, and more or less dependent upon solar influence, and other causes of a cosmic kind.

The action of volcanoes is plainly connected with heat, and earthquakes must, according to the Seismological philosophers, be considered to belong to the same category of phenomena. "An earthquake in a non-volcanic region," says the British Association *Catalogue*, "may, in fact, be viewed as an uncompleted effort to establish a volcano. The forces and impulse are the same in both; they differ only in degree of energy, or in the varying sorts and degrees of resistance opposed to them." These considerations give an additional interest to the investigation of the products of volcanic action, because the nature and condition of the gaseous and solid materials ejected from craters in eruption may afford some clue to those subterranean conditions of matter under which the disturbance was produced.

The study of earthquakes and volcanoes may lead to our acquiring some knowledge of the changes that take place below the surface of the globe; but, except in an indirect manner, they are not likely to bring us information from *great depths*, as the focus of disturbance in the best examined cases has not been found to lie far below the surface.

From Mr. Milne's tables, it appears that the period of the year in which earthquake action is most abundant is when both the actual height of the barometric column is the minimum, and the range of its oscillations the greatest. The atmospheric

changes made known to us by the barometer indicate an enormous difference of pressure where great areas are concerned, and this, together with the marked variations in rainfall that accompany oscillations of the barometric column, may well be supposed to exercise a powerful influence on the less stable portions of the crust of the earth.

But these atmospheric changes are dependent upon causes partly terrestrial and partly cosmic, of which the rotation of the earth and solar heat may be considered as the chief. We must also recognize the probable influence of the moon, known to be so great in the production of oceanic tides, and, as would appear from the analysis of earthquake catalogues by M. Alexis Perry, in some way ancillary to the promotion of concussions and oscillations in the strata of our globe.*

LITERARY NOTICES.

A History of the Fishes of the British Islands, by Jonathan Couch, F.L.S. Vol. II. *Groombridge.*—The second volume of Mr. Couch's valuable work contains an account of seventy-four fishes, and is illustrated by sixty-three of those accurately-drawn and beautifully-coloured plates which are better than all descriptions for purposes of instruction, or identification, and at the same time produce a highly artistic and ornamental effect. Many fishes of great interest are described in this volume, such as the Gurnards, remarkable for brilliant colouring and for possessing highly-developed air bladders, that, in some species at least, are capable of producing vocal sounds. Mr. Couch tells us that the air bladder of this family vary in shape according to the species, but all are firm in texture, and have muscular fibres interwoven in their fibrous tissue. The reader will recollect that in our first vol. (p. 324), under the head of "Vocal Fishes," there is an account of Dr. Dufosse's researches, in which he ascribes the sounds produced by the Gurnards and Dories to the vibration of these muscles. We have also an account of the Opah and the Bergylt, which live at great depths,

* The *Tenby Observer* mentions a curious phenomenon that may be connected with the late earthquake, having occurred on the same day. It was seen in Carmarthen Bay, and the account states, that—"From a base extending some three or four miles in the direction of Amroth Castle an immense piece of water, of a dark brown colour, as if holding earth in solution, seemed to be pushed forward in the form of a cone, of course surrounded by water of a natural colour. It steadily advanced in the same form towards Monkstone, and thence some miles to sea. Some friends in amusing themselves with fishing were not a little startled by the strange sight. When the coloured water overtook the boat they found that the point of division between the colouring was maintained throughout the depth of the water; the boat was violently pitched about, and the water thrown completely over it. It was observed first at about eleven a.m."

where the pressure must be enormous, the temperature very cool, and the quantity of light excessively small, and which nevertheless glow with magnificent tints, popularly imagined to be peculiar to regions that are exposed to the warmth and illumination of a tropical sun. The Goby family likewise supply much interesting matter, which the possessors of aquariums will appreciate, as some of the Gobies are among the most elegant of their captives. The Remoras and Sucking Fishes also occur in our list, and the Shanny, which climbs out of the water and basks on a sunny rock. Mr. Couch kept one of these fishes for six months, and he tells us that in the summer it would lie for hours together on a stone, and passed half its time out of water. Cooler weather induced it to remain in the liquid element under shelter of a stone. Reading these and similar instances shows us that a "fish out of water" may be an image of enjoyment as well as of discomfort, and facts of this kind bridge over the gulf that separates the atmospheric from the aquatic tribes. It should, however, be remarked, that fishes which can live for a time in air keep their gills moist, and are furnished with a slimy varnish that arrests evaporation from their skin. This volume cannot fail to enhance the great popularity which has hitherto attended Mr. Couch's scientific and praiseworthy labours.

A Manual of Popular Physiology, being an attempt to Explain the Science of Life in untechnical Language, by Henry Lawson, M.D., Professor of Physiology in Queen's College, Birmingham, etc.—*Hardwicke.* Professor Lawson is an able physiologist, and, as our readers know by the excellent papers from his pen that have appeared in our pages, he possesses in a high degree the art of presenting a difficult subject in a clear and interesting light. This little volume bears obvious marks of extensive knowledge, and capacity for imparting it; but while we praise it for its excellent qualities, we must be permitted to regret that its author did not implicitly trust to his subject and to his own natural talent in dealing with it. The incongruous matter frequently introduced for the sake of amusing the reader, will in many cases have an opposite effect, and tend to divert attention from the substantial merit of the work.

A Description of certain Dry Processes in Photography, specially adapted to the use of the tourist, by George Kemp, M.D. *Davies, London: Greenwood, Liverpool.*—This little book is not adapted to beginners in photography, and those who have had experience will only care to read certain portions that may be new to them. We extract one paragraph that may be useful to some of our microscopic readers. "Take, for instance, the very beautiful ciliary processes of the *Balanus porcatus*—the common rock barnacle of our coasts—and arrange them on a small plate of glass; with careful washing all the salt water and its solutions may be removed; the whole should be placed in a slow oven, or under the receiver of an air-pump, to dry, and then a few drops of moderately thin uniodized and freshly-prepared collodion poured over the specimen. This, when dry, may be floated off the plate into a vessel of clear

water, with four or five drops of glacial acetic acid, and when sufficiently washed and dried, be appropriately trimmed and mounted for the microscope."

On the Method of Observing Variable Stars, by George Knott, LL.D. Lond., F.R.A.S., and Joseph Baxendell, F.R.A.S., etc. Printed for private circulation. In a former number we mentioned the formation of a "Variable Star Committee," whose special function is to watch and collect information concerning variable stars; and we likewise published a short paper by Mr. Knott,* explaining the method to be adopted in these curious and important investigations. The pamphlet now before us conveys more detailed information on the same point. The writers recommend the magnitude of stars to be determined according to the plan of the Rev. R. Dawes, by ascertaining the exact amount of aperture at which they cease to be visible, and they supply examples of the mode of comparing one star with another, of estimating the difference between them, and of recording the observations. We presume that this pamphlet may be obtained on application to Mr. Knott, Woodcroft Observatory, Cuckfield, or to Mr. Joseph Baxendell, Manchester; but we should have thought it better that the Variable Star Committee should have issued it as their official code of directions. There can be no doubt that the observation of variable stars, and an accurate register of their increase and decrease of brilliance, and of the exact time occupied in such changes, is calculated to throw much light upon obscure but very interesting questions of stellar astronomy; and it is a work in which private students may successfully engage, as it will not require the costly apparatus of a regular observatory, nor make extravagant demands upon their knowledge and skill. It is, however, a kind of labour in which systematic co-operation is of great advantage, and we recommend that all who are disposed to engage in it, should at once put themselves in communication with Mr. Knott and Mr. Baxendell.

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

At the recent meeting of the British Association several examples were brought forward demonstrating the direct bearing of scientific researches upon the advance of medical science. No sooner is any new substance (whether an elementary body, such as thallium, or a compound) discovered, than experiments are made to investigate its physiological and therapeutical action on the living organisms of men and animals. In many cases these experiments are made by the observers on their own bodies, and the records of science offer

* See Intellectual Observer, April, 1863, p. 212.

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several examples of enthusiastic investigators whose lives have been perilled by the self-administration of dangerous re-agents.

As a rule, these investigations are made, in the first instance, on the lower animals; but the results so obtained only give a very slight approximation to what would be the nature of the action of these bodies on the human frame.

We know absolutely nothing of the different constitutional powers in the different animals, so that our only means of acquiring a knowledge of the therapeutical action of remedies is by direct experiment in every case.

For example, the goat and the sheep are so slightly different in structure and organization that it is difficult even to discover a well-defined specific distinction between the two animals. Nevertheless, many substances are fatal to the sheep that the goat eats with impunity. A goat will eat at a meal a sufficient quantity of laurel twigs (*Cerasus Lauro cerasus*) to destroy the life of a cow, a ruminating animal, whose organization closely resembles its own. In the same manner, tobacco—one of the most fatal of all poisons to the human frame—is eaten by goats and monkeys with great avidity, and without any apparent evil consequences.

Among the most important new remedies which science has bestowed upon medicine may be mentioned the preparations of the element bromine.

Bromine, as is well known, belongs to the same group of elements as chlorine, iodine, and fluorine; each of these, though perfectly capable of replacing each other in chemical combinations, has a totally different action on the vital organism.

Chlorine is an essential to the life of all animals, and is supplied in the form of common salt, chloride of sodium. Iodine is, both when simple and in combination, a powerful stimulant, exciting the glandular system.

Fluorine, though never yet isolated, is in some of its combinations a powerful poison.

Bromine has been discovered by Dr. Gibb to possess, when administered in the form of bromide of ammonium, $Br\ N\ H_4$, a power of producing insensibility or even partial paralysis of the nerves going to the glottis and larynx, or organs situated at the top of the windpipe.

This knowledge has been at once applied to practical medicine. The painful disease known as whooping-cough owes its chief danger and discomfort to spasm of the nerves going to the respiratory organs. It has been found that the administration of a few grains of bromide of ammonium three times a day has the effect of allaying this spasm, and so preventing the most dreaded symptoms of the disease.

Having alluded to the newly-discovered metal, thallium, it may be as well to mention that M. Lamy states that continued investigation into its properties has resulted in extreme lassitude and pain in the lower limbs. With a view of determining its real influence on the animal economy, he has administered it to the lower animals, and he mentions that a decigramme of the sulphate given to a dog

has caused death in forty hours. Mr. Crookes, on the other hand, denies its power, and states that he has occasionally swallowed a few grains of its salts without injurious effect.

Mr. Crookes' further researches on Thallium have brought forward several points of great interest. In testing for thallium in the flue-dust of pyrite burners, he finds that the spectrum analysis is useless from its extreme delicacy; $\frac{1}{1000}$ part of thallium in a mass being indicated as strongly and vividly as the pure metal itself.

Mr. Crookes has been experimenting upon several tons of this dust. The most ready method of extraction he finds to consist in washing it with pure water, accidulating the liquid with hydrochloric acid, so as to convert the thallium into chloride. In this manner he has obtained from three tons of flue-dust sixty-eight pounds of impure chloride, which was afterwards converted into sulphate by heating with sulphuric acid; this conversion into chloride and reconversion into sulphate being repeated, in order to get rid of impurities. Finally, the sulphate was reduced to the metallic state by fusing with blax flux or with cyanide of potassium. Thallium melts at 550° Fahr., and can consequently be easily fused over a gas jet, its surface being protected from the air by a stream of coal-gas.

Mr. Crookes exhibited a mass weighing upwards of a quarter of a hundredweight, and demonstrated its more obvious properties. It is the softest of the non-alkaline metals, being easily scratched by a point of lead. When obtained in larger quantity, thallium will doubtless be employed to furnish a magnificent green flame. Eight parts of chlorate of thallium, two of calomel, and one of resin yields a splendid light on being ignited, and a very little reduction in price would enable it to be used for ship-signals; its extraordinary intensity and monochromatic character enabling it to penetrate through a hazy atmosphere, which alters altogether the colour of the ordinary green lights produced by the salts of baryta.

SOCIAL SCIENCE CONGRESS.

Alleged Elevation of the Coast Line of the Lothians.—On the occasion of the members of the Social Science Congress visiting the Bass Rock, in the Firth of Forth, Mr. Bryson described the geology of the district, particularly with reference to the alleged rise of the coast line of the Lothians—one of the circumstances from which Sir Charles Lyell has adduced an argument in support of his views on the antiquity of man. Mr. Bryson maintained that no violent upheaval had taken place, but that the deposit on the shores of the Firth had been caused by a great wave of translation, which had thrown up the various marine remains that are now to be found far elevated above the water line along the coast.

ENTOMOLOGICAL SOCIETY.—*Oct. 5.*

Destructive Habits of Larvæ of Noctua segetum.—The importance of study of practical entomology was evidenced by Mr. S.

Saunders, who described the ravages of the larvæ of the *Noctua segetum* on the young of Swede turnips. Many acres of this important crop had been destroyed by these grubs, which, attacking only that portion of the root below the surface of the earth, were protected from the action of any ordinary remedy. Mr. Saunders suggested that the only probable remedy would be the destruction of the eggs of the moth before hatching. Mr. Stainton described the singular situation of the pupæ of the *Tortrix grandævana*. The larvæ of this insect feeds on the roots of the common coltsfoot, on the shores of the Baltic, and subsequently forms tubes the size of the finger in the sand, turning to pupæ in these tubes. Frequently the loose surrounding sand is blown away, when the exposed tubes are opened by birds, who devour the insect.

NOTES AND MEMORANDA.

Thunderstorms and the Moon.—M. Bernardin calls the attention of the Belgian Academy to the fact that many thunderstorms have occurred about the period of the new or full moon, and he invites inquiry for the purpose of ascertaining whether there is any connection between the movements of our satellite and the electrical condition of the atmosphere.

Artificial Fecundation of Plants.—The *Monitœur* has published an account of the process of M. Hooibrenck, which is reported to increase the fertility of cereal and other plants. When the grain is in flower, he passes over it an apparatus consisting of a string set with tufts of wool, close together, and having small lead weights between them. He repeats this brushing of the flowers three times, at intervals of two days. Espalier fruit trees he deals with in another fashion. First, he touches the stigmata with a finger carrying a little honey, and then brushes the flowers lightly with a powder-puff. By this means pollen is brought into contact with the honey, and adheres. Larger trees he reaches with a sort of brush, composed of tufts of wool. A commission appointed by the Minister of Agriculture reports very favourably upon these processes, as increasing the yield of corn, and they observe, that the fruit trees operated on produced an abundant crop, but they could not so easily satisfy themselves to what cause it was due. The Emperor has directed that these and other experiments of M. Hooibrenck shall be repeated on two of the imperial farms.

Effects of Belladonna.—In the month of September we saw a magnificent specimen of the Deadly Nightshade, *Atropa belladonna*, growing in a chalk dell in Hertfordshire, near Wheathampstead. It formed a splendid bush, spreading out on all sides, the stems five or six feet long, and the berries quite as large as small damsons. Shortly afterwards, the plant was visited by a young lady, accompanied by a gentleman, who cut a branch, which she held while he cut some more, and then walked away with the branch in her hand. In a few minutes she felt uneasy, and shortly afterwards was seized with violent headache, giddiness, and nausea. These symptoms continued for the rest of the day, through the night, and through the following day, when her eyes were very heavy, and she found herself unable to walk on account of the giddiness. On the third day the headache was better, but pain in the side had come on, and considerable debility. Six days after the first attack, the headache and sickness began to return, but were removed by a little brandy and water. The pain in the side did not cease till some days later. These facts indicate the great caution that should be used in dealing with this remarkable poison, to the influence of which some constitutions are peculiarly sensitive.

Novelty in Cattle Breeding. The *Archives des Sciences*, for September,

1863, contains a communication from a Swiss agriculturist, stating, that in February, 1861, he received from Professor Thury, of Geneva, a letter containing confidential instructions, which he was to carry out for the purpose of experimentally verifying an assumed law regulating the production of the sexes among animals. The result was, that in twenty-two successive cases, females were obtained, according to desire. The animals bred from, were Swiss cows and a Durham bull. M. Cornaz then purchased a Durham cow, and desired to procure, by breeding, a Durham bull, in which he succeeded. He also desired to breed six bulls, crossed between Durham and Schwitz, and by selecting cows of the colour and height he wanted, he was again successful, and regards Professor Thury's method as of the highest importance to breeders of cattle.

The law enunciated by Professor Thury, and confirmed by M. Cornaz, is, that sex depends on the degree of maturation of the egg at the moment of fecundation. In uniparous animals, fecundation at the commencement of the rutting period gives females, at its termination, males. In multiparous creatures, the first eggs that descend from the ovary generally give females, the last males; but M. Thury says, that in a second generative period that succeeds the first, circumstances are considerably changed, and the last eggs give females. Many of our rural readers, engaged in agriculture, will be able to verify these curious statements, which may have an important influence on the profits of farming.

New Metal.—M. M. Reich and Ritter have discovered a metal distinguished in the spectroscope by an indigo blue ray, and which they call *Indium*. They obtained it from a composite mineral, chiefly composed of sulphur, arsenic, iron, and lead.

New Planet, 79th.—We learn from the *Astronomiche Nachrichten*, that Mr. James Watson, of Ann-Arbor, U.S., has discovered a new planet of the 9·3 magnitude. It was seen by Oppolzen in Vienna on 6th October.

Mr. H. J. Carter on Rhizopods.—In *Annals of Natural History* this gentleman states that he has demonstrated the existence of chlorophyll cells in the body of *Difflugia pyriformis* as part of its organization. Starch granules, he affirms, form "part of its products," and he states that the tests conjugate. These circumstances, he considers, show the strong alliance between the Rhizopods, which he regards as *animals*, and the vegetable kingdom. He likewise describes a new Rhizopod, found in bog water, on the south coast of Devon. It is "globular, subround, green, loricated, spiniferous, and tentaculiferous. Spines straight, hollow, of uniform breadth in the shaft, bifid, or forked, at the distal, and discoid at the proximal extremity; very numerous, apparently rigid, radiating, or turned across each other, and moveable, as the spines in Echinus." Lorica, 1-411″, species, 1-740″ long.

Sunlight Illumination for the Microscope.—Mr. Wenham states, in *Quarterly Journal of Microscopical Science*, that fine markings on objects may be seen by placing the microscope in strong sunlight, and employing the concave mirror, and an achromatic condenser of large aperture. The eye could not support this blaze without protection, but by placing the red and green glasses of a sextant over the eye-piece, it was toned down, and the markings on all the most difficult tests easily and quickly brought out with remarkable distinctness.

Dry Mounting for Microscopic Objects—Mr. T. S. Ralph, of Melbourne, communicates to the *Quarterly Journal of Microscopical Science* his mode of mounting certain objects. He punches rings out of thin gutta percha. One of these rings is placed on a glass slide, and the object arranged in the centre. A covering glass is then placed on the ring, the slide made warm to soften the gutta percha, and gentle pressure applied, by which it is made to adhere to both glasses. The edge of the cover is finally varnished.

Use of Dead Sea-water.—M. Roux has laid before the French Academy an analysis of this water, which shows that, in addition to considerable quantities of chlorides of magnesium, sodium, calcium, and potassium, it contains bromide of magnesium to the extent of 0·364 grammes in 100·000 grammes. M. Roux considers that it may prove a very valuable medicine in scrofulous, syphillitic, and many other affections. Shall we have this locality converted into a fashionable

watering-place, and find dead sea-water figuring amongst the articles of our import trade? It is evident that if bromides come into greater demand for photographic, medical, and other purposes, they might be economically prepared on this spot, at least to the extent of evaporating the water in shallow basins by natural heat, and sending the solid residue to our laboratories for further manipulation.

The Composition of Ozone.—*Comptes Rendus*, No. 14, 1863, contains an important paper on ozone by M. J. L. Soret, presented to the French Academy by M. Regnault, in which, amongst other facts, he states that if ozone is destroyed by heat, by bringing a platina spiral passed up into a globe containing ozonised oxygen to a dull red heat, the volume of oxygen is considerably increased, while a very slight increase takes place in oxygen that has not been ozonized. For this and other reasons, the writer regards ozone as composed of more than two atoms of oxygen. M. Soret observes that many chemists regard oxygen in its ordinary gaseous state as composed of two atoms, OO, and he says we may conceive molecules of ozone to consist of three atoms of oxygen, OOO, and to constitute a binoxide of oxygen. He thinks it may contain *more* than three atoms of oxygen, but to determine the exact number its density should be known.

Infusoria and Germination.—M. J. Lemaire states in a note to the French Academy that if powdered porcelain is placed over a mass of moistened beans, barley, or oats, bacteriums make their appearance in about twenty hours, and vibrions and monads in forty-eight hours. The porcelain fragments may be made red hot, and the distilled water used without changing this result. Phenic acid stops both the production of infusoria and the germination. If the acid is removed, the infusoria appear, and the seeds germinate.

Novel Case of Marine Phosphorescence.—M. Morellet informs the French Academy that after taking a sea-bath near Penols, Herault, the bathing dress he wore, and that of his companion, were rinsed in the sea-water, and placed in a basket, where they remained till nine P.M., at which time they were taken out, and emitted sparks when touched. Three days afterwards he repeated his bath, but the clothes were not affected. The first bath took place in August on a hot day.

Beautiful Polariscope Object.—F. R. Martin informs us that if the beautifully crystallizable compound called "Santonine" (which is obtained from *Artemisia contra*), is dissolved in chloroform, and a little of the solution placed on a slide, and very gradually evaporated over a spirit-lamp, it will be observed, on making starting points for crystals with a fine needle, to form into beautiful satin-like rosettes, making a magnificent object for the polariscope, similar to the well-known Salicine slides.

Volpicelli on Spectral Analysis.—According to *Cosmos*, this observer states that "when solar light traverses our atmosphere, the rays appear in the same number and intensity, whether the air be dry or moist. This result accords with the ideas of M. Janssen, who attributes the telluric rays in the spectrum to the obliquity of the coincidence of the solar rays, and not to the influence of vapour of water. M. Volpicelli caused the solar rays to traverse an oxyhydrogen flame, the primitive atmosphere being dry; the telluric rays were not augmented in number or intensity." He concludes, in opposition to Secchi, "that the vapour of water is not the principal cause of the formation of the telluric rays."

G. E. R.

Face of Big Canon, on the Colorado River.